143—22

RECORD, CASE No. 13,482.

SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1891.

TERM No., 323.

MARGARET C. FREEMAN, APPELLANT,

vs.

GEORGE ASMUS.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE EASTERN DISTRICT OF PENNSYLVANIA.

FILED JANUARY 30, 1889.

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1 In the Circuit Court of the United States in and for the Eastern District of Pennsylvania, in the Third Circuit.

GEORGE ASMUS
versus
MARGARET C. FREEMAN.

UNITED STATES OF AMERICA,
Eastern District of Pennsylvania, } ss:

Pleas and proceedings before the honorable the judges of the circuit court of the United States in and for the eastern district of Pennsylvania, in the third circuit, of April session, 1884, No. 8.

It is thus contained:

Be it remembered that on the seventh day of March, in the year of our Lord one thousand eight hundred and eighty-four, George Asmus, by his solicitors, Messrs. Bakewell and Kerr, comes
2 into court here and files his bill of complaint against Margaret C. Freeman in the words and figures following, to wit:

3 United States Circuit Court, Eastern District of Pennsylvania.

GEORGE ASMUS
versus
MARGARET C. FREEMAN. } No. 8. In Equity.

To the honorable the judges of the circuit court of the United States in and for the eastern district of Pennsylvania:

George Asmus, of the city, county, and State of New York and a citizen of said State, brings this bill of complaint against Margaret C. Freeman, a citizen of the State of Pennsylvania.

I. And thereupon your orator complains and says that on or before the 5th day of November, in the year one thousand eight hundred and sixty-seven, one F. W. Luermann was the true, original, and first inventor of a certain new and useful improvement in blast furnaces not known or used before and not for more than two years prior to the date of his application for a patent in public use or on sale with his consent or allowance.

4 II. And your orator further shows unto your honors that the said F. W. Luermann, having made due application therefor and in all respects complied with the conditions of the then existing law of Congress, obtained letters patent of the United States, No. 70147, dated November 5th, 1867, for his said invention, and that said Luermann having assigned his said invention and letters patent to your orator, your orator, for good and lawful cause, surrendered the said letters patent No. 70447 to the Commissioner of Patents and obtained a reissue of the said letters patent in accordance with law for the residue of the term thereof; which said reissue is numbered No. 3204 and dated November 24th, 1868, as by the said last-mentioned letters patent, or a duly authenticated copy thereof in court to be produced, will fully and at large appear.

III. And your orator further shows that he has caused the said improvement to be extensively applied to practical use and granted a large number of licenses to use the same, and has been, and, but for the infringement by the defendant hereinafter complained of and by others, your orator would still be, in the undisturbed possession, use, and enjoyment of the exclusive privileges secured by the said reissued letters patent and in receipt of the profits of the same.

IV. And your orator further shows unto your honors that on the 17th day of October, 1877, your orator brought suit in equity in the United States circuit court for the western district of Pennsylvania against The Dunbar Furnace Co., Charles Parish, and A. B. De Saulles for an injunction and account of damages and profits for the infringement of the said reissued letters patent; that the said Dunbar Furnace Co. *et al.*, defendants therein, filed their answer to the said bill, denying the validity of the said reissued letters patent, the novelty of the invention therein described and claimed, and the infringement thereof by them; that issue was joined,
5 proofs taken, and the cause presented to the said court, the Hon. Wm. McKennan, circuit judge, presiding, by counsel for both parties, and that thereupon Judge McKennan gave a decree sustaining the said reissued letters patent as valid and granting an injunction and an account against the said defendants, all of which matters and things are of record and unreversed at No. 215, November term, 1877, in the equity docket of said court.

V. And your orator further shows unto your honors, as he is informed and believes, that the said defendant herein named, well knowing all the facts hereinbefore set forth, is now constructing and using blast furnace in some parts thereof substantially the same in construction and operation as in the said reissued letters patent mentioned, the exclusive right and privilege to make and use which, and vend the same to others to be used, is by law vested in your orator.

VI. And so it is, may it please your honors, that the said defendant, as your orator is informed and believes, without the license of your orator, against his will, and in violation of his rights, has made and used and intends to continue still to make and use the said improvements within the eastern district of Pennsylvania, and refuse to pay to your orator any of the profits which she has made by such unlawful manufacture and use or to desist from the further infringement of said reissued letters patent; all of which acts and doings are in violation of the exclusive rights and privileges so as aforesaid vested in your orator under and by virtue of said reissued letters patent and are contrary to equity and good conscience and tend to the manifest injury of your orator in the premises.

VII. To the end, therefore, that the defendant may, if she can, show reason why your orator should not have the relief hereby prayed, and that she may make a full disclosure and dis-
6 covery of all the matters aforesaid, and upon her corporal oath and according to the best and utmost of her knowledge, remembrance, information, and belief full, true, direct, and

perfect answer make to the matters and things hereinbefore stated and charged, and particularly to such of the several interrogatories hereinafter numbered and set forth, as by the note hereunder written are required to answer—that is to say:

1. Whether the said original letters patent No. 70447, hereinbefore mentioned, were granted and issued to F. W. Luermann on November 5th, 1867, for improvement in blast furnaces, as aforesaid.

2. Whether the said original letters patent No. 70447 were reissued to your orator on November 24th, 1868, as aforesaid.

3. Whether the said defendants or either and which of them has at any time and when and during what period of time made, used, or sold any and how many blast furnaces constructed in whole or in part upon the principles and in the manner described in reissued letters patent No. 3204, granted to your orator as aforesaid. Describe minutely and in detail their construction and operation.

VIII. And that the said defendant may answer the premises, and that she may be decreed to account for and pay over the income or profits thus unlawfully derived or which might have been derived from the violation of the rights of your orator as aforesaid, your orator prays that your honors, upon entering of the decree in favor of your orator against said defendant for infringement, as above prayed for, may also proceed to assess or cause to be assessed under your directions as well the profits or income to be derived therefrom, to be accounted for as aforesaid, also, in addition thereto, the damages sustained by your orator by reason of such infringements, and that your honors may increase the actual damages so assessed to a sum equal to three times the amount of such assessment, under the circumstances of the willful and unjust infringe-
7 ment committed by said defendant, as hereinbefore set forth; and, further, that the said defendant may be restrained from any further violation of the rights of your orator as aforesaid, your orator prays that your honors may grant a writ of injunction issuing from and under the seal of this honorable court or issued by one of your honors perpetually enjoining and restraining the said defendant and her clerks, attorneys, servants, agents, and workmen from any further construction or sale or use in any manner of said patented improvements or any part thereof in violation of the rights of your orator as aforesaid; and your orator further prays that a provisional or preliminary injunction be issued restraining the said defendant from any further infringement of said recited letters patent pending in this cause, and he prays for such other relief as the equity of the case may require and to your honors may seem meet.

IX. May it please your honors to grant unto your orator not only a writ of injunction conformable to the prayer of this bill, but also a writ of subpœna of the United States of America directed to the said Margaret C. Freeman, commanding her, on a day certain therein to be named, to appear and answer unto this bill of complaint and to abide and perform such order and decree in the prem-

ises as to the court shall seem meet and may be required by the principles of equity and good conscience.

GEORGE ASMUS.

BAKEWELL & KERR,
Solicitors and Counsel for Complainant.

NOTE.—The defendant is required to answer each of the foregoing interrogatories, numbered 1 to 3, inclusive.

BAKEWELL & KERR,
Solicitors for Complainant.

8 UNITED STATES OF AMERICA, }
Western District of Pennsylvania, } *ss:*

Before me, the subscriber, duly authorized to administer oaths, personally came George Asmus, the complainant in the foregoing bill named, who, being duly sworn, deposes and says that so far as the statements herein contained are within his own knowledge they are true, and as they are derived from the information of others he verily believes them to be true; and he further says that he verily believes the said F. W. Luermann in said bill named to be the original, true, and first inventor of the new and useful improvement in blast furnaces which is described in the reissue letters patent granted to deponent and mentioned in the foregoing bill; and, further, that the said deponent verily believes that the title of the said complainant is as set forth in said bill.

Sworn to and subscribed before me this 7th day of November, A. D. 1883.

[SEAL.] W. B. CORWIN,
Notary Public.

(Endorsed:) No. 8. April sess., 1884. U. S. circuit court, eastern district of Penna. In equity. George Asmus *versus* Margaret C. Freeman. Bill of complaint. Filed March 7, 1884. Samuel Bell, Esq., clerk. Issue subpœna, returnable to the first Monday of April next. Bakewell & Kerr, solicitors for complainant.

9 And afterwards, to wit, on the seventeenth day of May, in the year of our Lord one thousand eight hundred and eighty-four, the respondent, by her solicitors, William D. Baldwin, Esquire, and Wayne MacVeagh, Esquire, comes into court here and files her answer in the words and figures following, viz:

10 United States Circuit Court in and for the Eastern District of Pennsylvania. In Equity.

GEORGE ASMUS
vs.
MARGARET C. FREEMAN. } No. 8. April Session, 1884.

The Answer of Margaret C. Freeman, Defendant, to the Bill of Complaint of George Asmus, Complainant.

This defendant, now and at all times hereafter saving and reserv-

ing to herself all and all manner of benefit or advantage of exception or otherwise that can or may be had or taken to the manifold errors, uncertainties, imperfections, and insufficiencies in the said bill of complaint contained, for answer to said bill or to so much and such parts thereof as this defendant is advised it is necessary for her to make answer unto, answering, says:

I. This defendant denies that F. W. Lurmann was the inventor or the true, original, and first inventor of a certain alleged im-
11 provement in blast furnaces, as in said complaint alleged; she denies that said alleged improvement was new and useful; and she here, as more particularly hereinafter, denies that the same was not known or used before the supposed invention thereof by said Lurmann, and that it was not for more than two years prior to the date of his application for patent in public use or on sale in the United States both with and without his consent or allowance.

II. Upon information and belief this defendant admits that the said F. W. Lurmann obtained letters patent of the United States No. 70447, dated November 5, 1867, for an improvement in blast furnaces alleged to be of his invention; but she denies that the said F. W. Lurmann was the original and first inventor of the said alleged invention, and she denies that the said Lurmann made due application therefor, and that he in all respects complied with the conditions of the then existing law of Congress, as in said bill alleged.

III. Whether said Lurmann assigned his said alleged invention and letters patent to complainant, as in said bill alleged, this defendant is not informed, save by the allegations in that behalf in said bill contained, and, upon information and advice, denies said allegation, and leaves the complainant to make such proof thereof as he may be advised.

She admits that complainant surrendered the said letters patent No. 70447 to the Commissioner of Patents and obtained a reissue of said letters patent, which said reissue is numbered 3204 and dated November 24, 1868; but she denies that said letters patent No. 70447 were surrendered for good and lawful cause or that said reissued letters patent No. 3204 were obtained or granted in accordance with the law or for the residue of the term thereof, and she further denies that the said reissued letters patent No. 3204 were for the same invention which was specified in the said original letters patent
12 No. 70447, but, on the contrary, this defendant avers that said reissued letters patent were obtained on the application of an assignee and without the knowledge or consent of the inventor for the purpose of expanding or enlarging the claims thereof so as to cover an invention other and different from that described and claimed in said original letters patent, and that the said reissued letters patent as allowed and issued were unlawfully and unwarrantably expanded and enlarged and cover inventions other and different from and broader than those described and claimed in said original letters patent, and that said reissued letters patent are therefore void.

IV. This defendant is not informed, save by said bill, whether or

not the complainant has caused the said alleged improvement to be extensively applied to practical use and granted a large number of licenses to use the same, and leave the complainant to make such proof in that behalf as he may be advised.

V. This defendant denies that she is now infringing or has at any time infringed the said alleged improvement or any part or parts thereof, as in said bill alleged, or that she has done or intended to do anything to disturb the possession, use, and enjoyment of the alleged exclusive privileges secured by the said reissued letters patent and the receipt of the profits of the same, as in said bill alleged.

VI. This defendant believes it to be true that complainant brought suit in equity in the United States circuit court for the western district of Pennsylvania against The Dunbar Furnace Company, Charles Parish, and A. S. Desaulles, but not at the time alleged in said bill; but this defendant, on information and belief, charges that the said suit or proceeding against The Dunbar Furnace Company and the other defendants was not, in any fair sense, an adversary suit or proceeding, and that the statements in the bill of com-
13 plaint in the fourth paragraph thereof as to the same are incorrect, misleading, and untrue; that it is true such a suit was commenced and that some evidence was taken therein on the part of the complainant, but that there was no proper defence to said suit, no testimony taken on behalf of the defendants, and no cross-examination of the complainant, the principal witness in the case; that no service was made upon one of the defendants; that no answer was ever filed by him; that a decree was entered for the complainant against all the defendants, notwithstanding such want of service, and the case referred to a master for an account of profits and damages and an injunction ordered to issue, but, so far as these defendants have been able to ascertain, no such writ of injunction was ever granted and no further proceedings were ever had before the master and no final decree was ever entered in said suit.

This defendant further says that she was not party or privy to said alleged suit, and that she is not bound or concluded by the decision therein.

VII. This defendant denies that she is now constructing or using any blast furnace, in some parts thereof or any part thereof, which is substantially the same in construction and operation as in the said reissued letters patent mentioned, the exclusive right and privilege to make and use which and vend the same to others to be used is by law vested in said complainant.

VIII. This defendant denies that she has violated any rights of the complainant or has made and used or intended to make and use the said alleged several improvements or any or either of them within the eastern district of Pennsylvania or elsewhere, or that she has done or intended to do anything in violation of said reissued letters patent or of the alleged exclusive rights and privileges of said complainant thereunder or by virtue thereof.

14 IX. This defendant, further answering, says that shortly after the above-mentioned decree in the suit of the Dunbar Furnace Co. complainant alleged that this defendant and her asso-

ciates were infringing the said Lurmann patent and called their attention to said suit; that they replied, denying said infringement or any intention of infringement, and requested to be informed in what the infringement consisted; that complainant replied, reiterating the charge of infringement, but without specifying wherein it consisted. Upon their refusal to listen to his demands, without knowing specifically what they were, complainant's attorney wrote specifying the alleged ground of infringement, referring to the Dunbar suit, and suggesting a settlement; that upon the advice of counsel, after full investigation, they declined to recognize said complainant's alleged rights, and that for more than three years they heard nothing more of complainant's alleged rights, during all of which time their furnaces were in operation with the full knowledge and acquiescence of said complainant.

X. This defendant, further answering, says that the interrogatories contained in the 7th paragraph of the bill of complaint have all been hereinbefore specifically answered. As an additional answer to the 3d section thereof, this defendant denies that she has at any time made, used, or sold blast furnaces constructed, in whole or in part, upon the principles and in the manner described in said reissued letters patent No. 3204, the only furnaces used by her being constructed in substantial accordance with letters patent No. 209,119, granted October 22, 1878, to Henry C. Grittinger, the manager of this defendant's and her associates' works at Cornwall, Pennsylvania, with the exception of the omission of the water-cooling pipe in the weight plate and around the slag-discharge opening, the use of such water pipe having been for some time discontinued, this defendant not using any water-cooled arrangement to regulate or control the flow of slag through the furnace.

15 XI. This defendant, further answering, upon information and belief denies that the said reissued letters patent No. 3204, dated November 24, 1868, is valid; but, on the contrary, alleges that it is invalid and void for the following reasons, to wit:

1st. Because said reissue application was never assented to, signed, or sworn to by the inventor.

2d. Because it is for an invention different from that claimed in the original patent.

3d. Because the said reissue contains much new matter interpolated by the assignee.

4th. Because the specification of said reissued letters patent is not sufficient to enable any person skilled in the art or science to which the alleged invention appertains to make, construct, and use the same with practical success.

5th. Because the alleged improvements attempted to be patented in said letters patent did not involve or require invention and did not differ in any patentable respect from what was before said alleged invention known and used in this country or described in patents and printed publications.

6th. Because there is no patentable combination between the elements constituting the first claim of said reissued letters patent, and because no invention was required to produce the same.

7th. Because the specification of said reissued letters patent does not sufficiently describe the method of controlling the discharge of slag from blast furnaces by regulating the temperature of the slag-discharge piece, as claimed in the 7th claim of said reissue, to enable persons skilled in the art or science to which it appertains or with which it is most nearly connected to practice the same; that said method did not involve or require invention and did not differ in any patentable respect from what was before said alleged invention known and used in this country or described in patents and printed publications.

16 8th. Because the 7th claim of the said reissued letters patent No. 3204 is void if construed to cover all methods of controlling the discharge of slag from blast furnaces by regulating the temperature of the slag-discharge piece, because it is not for an art, machine, or manufacture or composition of matter or for any improvement on either.

9th. Because the apparatus or alleged invention described, shown, and contained in said patent is not a patentable invention, but is inoperative and incapable of being applied to practical use without the further exercise of inventive skill or experiment.

10th. Because the said F. W. Lurmann was not the original or first inventor or discoverer of the thing patented in said reissued letters patent No. 3204 or of any substantial or material part thereof, but that long prior to said alleged invention or discovery by the said Lurmann the thing so patented or a substantial and material part thereof or substantial and material parts thereof claimed as new in said reissued letters patent No. 3204 had been invented or discovered and used in public by and known — numerous persons whose names and residence and the localities of whose prior use are now unknown to these defendants, but which, when known, these defendants pray leave by proper amendment to insert in their answer.

17 11. Because the thing patented in and by said reissued letters patent No. 3204 or a substantial and material part or substantial and material parts thereof claimed therein as new had long prior to the alleged invention thereof by said Lurmann been patented or described or contained in letters patent numbered and dated and issued as follows, to wit:

U. S. letters patent No. 1057, granted to I. C. Bryant for blast furnace December 31, 1836.

U. S. letters patent No. 38513, granted to Stileman & Ellis for cupola furnace May 12, 1863.

British letters patent No. 1000, granted to Daniel Dalton for furnace dated, May 4, 1855.

British letters patent No. 1470, granted to George Bedson June 12, 1863.

French letters patent No. 12383, granted to —— Merle July 27, 1854.

12th. Because the thing patented in and by said reissued let-ers patent No. 3204 or a substantial and material part thereof or substantial and material parts thereof claimed therein as new had long

prior to the alleged invention thereof by said Lurmann been fully described, contained, and set forth in the following printed works and publications, to wit:

Kerl's Metallurgy, vol. 1, pages 157, 158, plate II, Fig. 33, the title of which is as follows: "Handbuch der Metallurgischen Hüttenkunde zum Gebrauche bei Vorlesungen und zum Selbstsudium. Bearbeitet von Bruno Kerl, Könige, Hannor, Hüttenmeister und Lehrer der Hüttenkunde und Probirkunst an der Könige, Bergschule zu Clausthal. In drei Bänden. Erster Band, mit 7 litographirten Tafeien. Freiberg: Vorlag von J. G. Engelhardt, 1855."

18 Percy's Metallurgy, pages 354, 356, 357, Figs. 29, 32, 44, the full title of which work is as follows: "Metallurgy: The Art of Extracting Metals from their Ores and Adapting Them to Various Purposes of Manufacture. By John Percy, M. D., F. R. S., lecturer on metallurgy at the Royal School of Mines. Iron and steel, with illustrations, chiefly from drawings carefully laid down to scale. London: John Murray, Albemarle street, 1864."

Also in sundry other patents and publications, the grantees and names and dates of which are now unknown to this defendant, but which when known this defendant prays leave by proper amendment to insert in this answer.

13th. Because in view of the state of the art at the time of the alleged invention by said Lurmann the claims of said reissued letters patent are too broad, covering inventions before made by others and of which he was not and his assignee is not entitled to the exclusive use and enjoyment.

14th. Because if said Lurmann or his assignee ever had a right to a patent for the alleged improvement specified in reissued letters patent No. 3204 or the right to have the same secured by letters patent he abandoned and forfeited the same and lost all such right by his delay in applying for letters patent therefor, and the same were put into public use and on sale in this country more than two years before his application for a patent thereon.

XII. And this defendant, further answering, denies the equity of said complainant's bill as prayed for in said bill of complaint.

Without this, that there is any other matter, cause, or thing in said complainant's said bill of complaint contained material or necessary for this defendant to make answer unto and not herein and hereby well and sufficiently answered, confessed, traversed, avoided, or denied is true to the knowledge or belief of this

19 defendant; all which matters and things this defendant is ready and willing to aver, maintain, and prove as this honorable court shall direct, and humbly prays to be hence dismissed with her reasonable costs and charges in this behalf most wrongfully sustained.

MARGARET C. FREEMAN,
By her attorney-in-fact, WM. COLEMAN FREEMAN.

WM. D. BALDWIN,
WAYNE MacVEAGH,
Of Counsel.

UNITED STATES OF AMERICA, }
Eastern District of Pennsylvania, } ss:

William Coleman Freeman, being duly sworn, deposes and says that he is the attorney-in-fact for the aforesaid defendant, Margaret C. Freeman, and as such more familiar with the facts of this case than is said defendant; that he has read the foregoing answer by him subscribed, and that the facts set forth in said answer are true of his own knowledge except such as are stated on information and belief, and as to those he verily believes them to be true.

WM. COLEMAN FREEMAN.

Subscribed and sworn to before me this 13th day of May, 1884.

L. M. LEIWIG,
Justice of the Peace.

20 (Endorsed:) No. 8. April sess., 1884. C. C. U. S., E. D. of Pa. Asmus *vs.* Freeman. Answer. Filed May 17, 1884.

21 And afterwards, to wit, on the fourteenth day of June, in the year of our Lord one thousand eight hundred and eighty-four, the complainant, by his solicitors, Messrs. Bakewell and Kerr, comes into court here and files his replication in the words and figures following, viz:

Circuit Court of the United States, Eastern District of Pennsylvania.
No. 8 of April Session, 1884.

GEORGE ASMUS
vs. } In Equity.
MARGARET C. FREEMAN.

The replication of the complainant, George Asmus, to the answer of the defendant, Margaret C. Freeman.

22 This repliant, saving and reserving to himself all and all manner of advantage of exception to the manifold insufficiencies of the said answer, for replication thereto says that he will aver and prove his said bill to be true, certain, and sufficient in the law to be answered unto, and that the said answer of the said defendant is uncertain, insufficient, and untrue; without this, that any other matter or thing whatever in the said answer contained material or effectual in the law to be replied unto, confessed and avoided, traversed and denied, is true; all of which matters and things this repliant is and will be ready to aver and prove as this honorable court shall direct, and humbly prays as in and by his said bill he has already prayed.

BAKEWELL & KERR,
Solicitors for Complainants.

23 (Endorsed:) No. 8. April session, 1884. U. S. circuit court, eastern district of Pennsylvania. In equity. George Asmus *versus* Margaret C. Freeman. Replication. Filed June 14, 1884. Bakewell & Kerr, solicitors for complainant.

24 In the Circuit Court of the United States, Eastern District of Pennsylvania.

GEORGE ASMUS
versus
MARGARET C. FREEMAN. } No. 8. April Sessions, 1884.

Complainant's Record.

Bakewell & Kerr, counsel for complainant.

25 In the Circuit Court of the United States, Eastern District of Pennsylvania.

GEORGE ASMUS
versus
MARGARET C. FREEMAN. } No. 8. April Sessions, 1884.

Examination of witnesses and other evidence on behalf of complainant under the 67th rule in equity, as amended, pursuant to agreement of counsel, before W. B. Corwin, notary public and special examiner, by consent of counsel, at the office of Bakewell & Kerr, No. 401 Grant street, Pittsburgh, Pa., beginning on June 27th at 10 o'clock a. m.

Present: Thomas B. Kerr, Esq., on part of complainant, and William D. Baldwin, Esq., on part of respondent.

GEORGE ASMUS, a witness produced on part of complainant, being duly sworn, deposes and says:

Int. 1. State your name, age, residence, and occupation.

Ans. George Asmus; age, fifty-four years; residence, New York city; occupation, mining engineer and metallurgist.

Int. 2. Are you the complainant in this case and the patentee of reissue letters patent No. 3204, dated November 24th, 1868, for improvement in blast furnace?

26 Ans. I am.

Int. 3. Are you familiar with the construction of the defendant's furnace in this case? If so, please describe it.

Ans. I am. The furnace is constructed with an absolutely closed front and the cinder is discharged directly from the hearth through an opening cooled by water. I produce a sketch showing how this is accomplished. The plate A has a prolongation of about twelve inches, reaching through the wall of the hearth towards the inside. This plate is thoroughly cooled by pipes through which water is constantly running. An opening about nine inches wide and ten inches high is left in this plate, through which the cinder is discharged. The rear of the dam-plate B is walled up.

Int. 4. Describe how the opening through the plate A is closed and how the tapping of cinder is effected.

Ans. The opening is filled with clay, and at proper intervals a hole is punched through this clay in order to tap the cinder.

Int. 5. In what direction is the opening through the clay made?

Ans. Horizontally.

(Sketch referred to by witness offered in evidence as "Exhibit Asmus Sketch No. 1.")

Int. 6. What do you mean by the expression "closed front" used in your third answer?

Ans. A blast furnace where the cinder discharge takes place directly from the hearth and not through the medium of a fore hearth, the latter being an outside part of the hearth proper at furnaces which are technically called open-front furnaces.

Int. 7. Please produce a sketch illustrating the construction of an open-front furnace.

Ans. The sketch I produce represents a vertical section, showing hearth A and fore hearth F of a blast furnace working with an open front. A tymp plate, E, often cooled with water, was in use long ago with such furnaces, but the cinder was not tapped directly from the hearth. It was taken out through the fore hearth F,
27 which manipulation caused a great loss of time and great deal of labor. The mode of operation at these open-hearth furnaces is this: The fore hearth F is filled with clay, and when the cinder has risen to the level of the tuyeres an opening is made with iron bars at a steep angle through the clay, and the cinder has to rise to the level of the dam D, over which it flows away. A part of the clay which is under the tymp plate E forms an intercepting trap, preventing the blast getting into the fore hearth. This part of the clay, marked in the sketch C, is called the stopper, and, as it is eaten away very quickly by the cinder flowing underneath it, it had often to be repaired. E indicates the iron tap.

Int. 8. You speak about a loss of time in the tapping of cinder in furnaces of the open-front construction. Please state what are the causes of that loss and what its effect is in the production of the furnace.

Ans. The loss of time in keeping the fore hearth in repair differs with different furnaces using different material, but on an average it amounts to two to three hours of time out of twenty-four. During the repair the blast has to be taken off, and no iron is made during that time. The hot blast cools off because no gas is produced during that time, and after the blast is let on again colder air as before is blown into the furnace, which also decreases the output—not only the output, but at the same time the quality of the iron produced—that is to say, a furnace fitted for working correctly with a certain degree of heat in its blast cannot be disturbed in this respect without damaging the product.

Int. 9. State what effect, if any, the furnace has on its fuel during the time that its blast is taken off.

Ans. There is air passing through the furnace by the open front, burning fuel slowly and doing no smelting, so a loss of fuel is the consequence.

Int. 10. You have spoken about a great deal of labor being required in the working of a furnace with an open front. Please state what that labor is and what causes the necessity for it.

Ans. As not only the cinder, but also the iron, is discharged

through the fore hearth, it is necessary to keep the same
28 always in such a condition that the iron discharge can be easily accomplished. The fore hearth, being a comparatively cold outside part of the hearth proper, is always filled with half-smolten clay and with half-smolten ore and unconsumed fuel mixed up with iron. This conglomerate of substances, being out of the reach of the blast, has to be removed frequently; else it will form a tough mass, which cannot be broken into for letting out the iron, and it is this cleaning out, which has to be done in most cases every time the iron is tapped, which causes much loss of time and the very hardest labor the furnace men were subjected to. With a closed front all this is done away with entirely. The iron is tapped by a short cut directly from the hearth, and so is the cinder.

Int. 11. Please state any advantages that occur to you in the use of the closed front or Luermann system over the prior open-front construction.

Ans. There is one advantage in the construction itself. The hearth, having no outside projection, becomes stronger by being held together like a barrel with hoops. The main advantages are in the fact that a closed-front furnace runs all the time under full pressure, not necessitating any repairs concerning the cinder discharge and not needing hard work done by skilled labor about the front parts, which are the weakest in open-front furnaces, while it is just as strong as any part of the hearth as soon as the closed-front system is adopted.

Int. 12. State what, if any, effect it has upon the output of the furnace and upon the amount of fuel used.

Ans. The effect as to output and saving of fuel is very different with different furnaces. Whenever a large amount of cinder is made, in consequence of lean ores, the destructive effect of the cinder outflow is greater than where rich ores are smelted. At an average I find that a saving of at least ten per cent. of fuel and more output of twenty per cent. of iron is effected by changing from the open-hearth system to that of the closed front. I have known of some instances where the output was doubled by making the change.

29 Int. 13. Please state what the general construction of the furnaces was prior to the introduction of the Luermann invention.

Ans. Open fronts.

Int. 14. You have spoken about closed-front furnaces. Please state what construction, if any, of cinder-discharge opening is used with such furnaces.

Ans. In building the hearth an opening is left in the wall at the proper height, a foot or two below the tuyeres, through which the cinder is tapped directly from the hearth, and this opening is protected by water-cooled castings or water coils from being eaten away or enlarged.

Int. 15. What effect, if any, would be produced by the tapping of the cinder in the absence of this provision for protecting the opening?

Ans. The brick-work of that part of the hearth where the cinder is discharged would be melted away by the cinder flowing through an unprotected opening.

Int. 16. State whether or not a closed-breast furnace without such provision for protecting the wall at the cinder opening would be a practically useful and operative furnace.

Ans. Such a furnace would not be practicable for the reasons given before, especially where hot blast, high pressure, and lean ores come together, all tending in their effects to destroy such an unprotected opening.

Int. 17. Referring now to the defendant's furnace as shown by "Exhibit Asmus Sketch No. 1," please state whether or not the construction is such as to effect the protection of the wall at the cinder outlet which you have just described.

Ans. It is. The cinder outlet C in the sketch is protected from three sides, it being made through the water-cooled plate A.

Int. 18. How far does the cooling effect of a water-cooled casting of the kind used by the defendant at the cinder-discharge opening of her furnace afford an efficient protection to adjacent parts of the wall?

Ans. The cooling effect of water plates, as they are usually made to protect brick-work at the furnaces, is practically to a distance of about six inches. It can be increased by the use of larger water pipes and higher water pressure if desired.

Int. 19. How large is the opening usually made through the clay stopper which is placed in the notch C of furnaces constructed like the defendant's when it is desired to tap the cinder?

Ans. About an inch.

Int. 20. How far from the lower side of the notch is the opening usually made?

Ans. About the middle of the notch.

Int. 21. State what, if any, advantages of the closed-breast system are obtained in furnaces constructed like the defendant's.

Ans. Defendant is by the construction she uses enabled to run the furnace without interrupting the blast. There is no fore hearth to be cleaned out, no time lost, and no labor to be performed in order to keep the cinder tap in shape.

Int. 22. State whether this invention has gone into use in any furnaces by your licenses; if so, what furnaces.

Ans. It has been adopted by a great many furnaces. For instance, the following:

Charlotte Furnace Company, Scottdale, Pa.
Graff, Bennett & Co., Pittsburgh, Pa.
Soho furnaces, "
Norton iron works, Ashland, Ky.
Shoenberger, Blair & Co., Pennsylvania.
Monticello furnace, "
Edgar Hill Iron Co., "
Cambria iron works, "
Bethlehem iron works, "
Pennsylvania steel works, "

Laughlin & Co., Pennsylvania.
Hooven & Sons, "
Westerman Iron Co., "
Isabella furnaces, "
Valley Iron Co., "
Siefert, McManus & Co., "
Spearman Iron Co., "
Scranton iron works, "
31 Brady's Bend iron works, Pennsylvania.
Muirkirk furnace, Maryland.
Brown, Bonnell & Co., Ohio.
S. M. Carpenter, "
A. Bradly, "
Belfast Iron Co., "
Cleveland Iron Co., "
Jackson Iron Co., Michigan.
Western Iron Co., Indiana.
North Jersey Iron Co., New Jersey.
Morris Iron Co., "
Gaylord Iron & Pipe Co., Kentucky.
Cedar Point furnace, New York.
Bay State Iron Co., "
Crane Iron Co., Catasauqua, Pa.
Chester rolling mills, Chester, Pa.
S. Robbins & Sons, Philadelphia, Pa.
Robert H. Coleman, Lebanon, Pa.
Edgar Thompson furnaces (Carnegie Bros.), Bessemer, Pa.
Lucy furnaces, Pittsburgh, Pa.
Dunbar furnaces, Dunbar, Pa.
Longdale Iron Co., Longdale, Va.
Low Moor Iron Co., Virginia.
Rising Fawn furnace (Walker Coal and Iron Co.), Georgia.
Eureka Co., Oxmore, Ala.
Belmont furnaces, Wheeling, W. Va.
Riverside furnaces, "
Top Mill furnace, "
Benwood iron works, "
Chattanooga iron works, Chattanooga, Tenn.
Hoggsett & Co., Fayette, Pa.
Bellaire iron & nail works, Bellaire, O.
Wheeling Iron Co., Wheeling, W. Va.
Junction Iron Co., near Steubenville, O.

(Sketch of the open-front construction referred to by witness in Int. 7 is now put in evidence as "Complainant's Exhibit Asmus Sketch No. 2.")

32 Int. 23. Please state when, where, and under what circumstances you saw the defendant's furnace and whether you ever made any demand for royalty for the same.

Ans. I saw the furnace on May 17th, 1883. It was in blast. It

was shown to me by the manager, Mr. Grittinger. I told him that I considered this construction as an infringement on my patent, and that the owner would have to take out a license. The furnace is situated near Lebanon, Pa., and is called the North Cornwall furnace.

(Counsel for complainant offers in evidence an uncertified printed Patent Office copy of the specification of reissue patent No. 3204, granted to complainant on November 24th, 1868, for improvement in blast furnaces, marked "Exhibit Complainant's Patent," certification of which is waived by counsel for respondent.)

(It is hereby stipulated that printed Patent Office copies of U. S. patents and Blue Book copy of British specifications may be used by either party in this case as evidence without certification, subject to correction at any time, by the production of certified copies, if desired.)

In answer to a question to that effect by counsel for respondent, counsel for complainant states that infringement of the first and sixth claims of the patent is charged against the defendant.

Cross-examination:

X Int. 24. Please examine "Exhibit Sketch No. 1" and your third answer relating thereto. You say defendant's furnace has an absolutely closed breast, while the sketch shows an apparent opening. Please describe the construction a little more clearly as to how the space between A and B is closed.

Ans. The space between A and B, as sketched in No. 1, indicates only that amount of distance to show that they are different plates. In fact, the lower edge of plate A is at a level with the upper edge of plate B, or nearly so.

33 X Int. 25. Please describe briefly the parts represented in that sketch No. 1 with regard to the reference letters marked thereon.

Ans. A is an upright plate, cooled by water, with a horizontal prolongation reaching about twelve inches towards the inside of the hearth, and in this plate, cut out of it and the prolongation, is the opening C, through which the cinder is discharged. The cooling water pipes extend through the whole plate A to the upright part and through the horizontal extension. The plate B is a little in front of plate A. The former is in circle with the outside of the hearth, while the plate A is set in deeper into the furnace, forming a niche apparently made to get nearer to the hearth where the cinder is fluid. The plate B may technically be called a dam-plate here, though the horizontal space between A and B does by no means constitute a fore hearth, the space being walled up and the cinder being discharged through the opening C by a horizontal thrust and directly from the hearth. D indicates the tapping hole for the iron.

X Int. 26. In "Exhibit Sketch No. 2" you represent an open-front or fore hearth furnace. How far in front of the tymp plate does such a fore hearth usually extend?

Ans. From two to four feet, according to the size of the furnace.

X Int. 27. As a matter of fact, are not furnaces frequently worked with a fore hearth not greater than ten inches?

Ans. There are furnaces which are running that way, but I never saw one before I introduced the Luermann's construction in this country. A fore hearth being only ten inches long is, in every technical sense of the word, no fore hearth any more. It is impossible to dig it out, and all those furnaces with such short distance between tymp and dam plate tap the cinder directly from the hearth and not from the lower part of the hearth under a stopper, which is, in fact, nothing but a downward prolongation of the tymp, constituting an intercepting trap between hearth and fore hearth. The very word "short neck," which is used for this imitation, is younger than Luermann's patent.

X Int. 28. At what point between ten inches and two feet,
34 in your estimation, would a fore hearth cease to be a fore hearth?

Ans. It would cease to be a fore hearth where it is impossible and at the same time unnecessary to repair a stopper, because only a very short distance between tymp and dam plate would make it possible to run the furnace without cleaning out the recess called fore hearth. I think the minimum of this distance must be at least two feet. If the fore hearth is long enough to enable the workmen to repair the stopper, it would be too long to allow running the furnace without cleaning out the fore hearth, the dam-plate being too far away from the real heat of the hearth, and the masses filling that fore part would chill, often making the iron tap difficult and in a great many cases impossible. Practice has shown that no recess at all is the best way, and a recess of ten inches is only an obstacle to the practical working of the furnace, it being a closed front with a part of the old disease and without its former intention. The old fore hearth was a necessity until it was found how the cinder could be run from a furnace without ruining that part of the wall, and this was by cooling it properly.

X Int. 29. Is that the best answer as to actual distances that you are able to give to the foregoing question?

Ans. Practically speaking, a furnace ceases to have an open front where the horizontal distance between tymp and dam plates is so much shortened that the tapping of the cinder straight from the hearth is possible and can be done constantly without the necessity of opening that front and cleaning it out. It is practically impossible to run a furnace on the open-front system, with a stopper or intercepting cinder trap, where the distance between tymp and dam is less than two feet.

X Int. 30. Then, practically speaking, I understand you to claim that a fore hearth of less than twenty-four inches ceases to be a fore hearth and becomes substantially a closed breast. Is that correct?

Ans. Practically, yes.

35 X Int. 31. Your "Exhibit Sketch No. 2" shows a stopper, C, projecting below the tymp and below the top of the dam-plate. For the sake of clearness, we will call the material clos-

ing the opening between this stopper and the wall D of the dam-plate the filling. Now, practically, how far below the top of the dam-plate does the stopper C of the blast furnace usually extend?

Ans. About eighteen inches. They hold it as deep as they can, but it eats away.

X Int. 32. With a downward projection of eighteen inches below the dam-plate on the part of the stopper and a distance of two feet between the adjacent walls of the two, at what angle would it be necessary to perforate the filling to secure the discharge of the cinder?

Ans. At an angle of about forty degrees, or something of that kind.

X Int. 33. And this angle would increase as the fore hearth is shortened, would it not?

Ans. Yes.

X Int. 34. Then, as I understand your construction of Luermann's patent, the horizontality of the discharge opening for the cinder has no relation to the question of infringement?

Ans. It is a direct cinder tap from the hearth, omitting an intercepting trap formed by the stopper, which, in fact, constitutes the closed front; there being no stopper, it follows that the closed front is made by a horizontal thrust. The downward thrust, as it is done at an open-front hearth, is made in order to form a stopper and to prevent the cinder in the hearth to be thrown by the pressure of the blast into the casting-house.

X Int. 35. Then, as I understand your last answer, it is the omission of the intercepting trap formed by the stopper which, in fact, constitutes the distinction between an open and a closed front furnace; is that correct?

Ans. Yes; it is the absence of the intercepting trap and the fore hearth which both constitute the open front.

36 X Int. 36. Then, as I understand it, your answers 8 to 12, inclusive, as to the relative advantages and disadvantages of the open and closed front furnaces have been based upon the understanding developed in your X answers 27 to 35, inclusive. Is that correct?

Ans. Yes.

GEORGE ASMUS.

STATE OF PENNSYLVANIA, }
City of Pittsburg. }

I, W. B. Corwin, notary public and special examiner in the within-named cause, do hereby certify that on the day herein named I was attended by Thomas B. Kerr, Esq., of counsel for complainant, and William D. Baldwin, Esq., of counsel for respondent and the witness herein named, at the office of Bakewell & Kerr, No. 401 Grant street, Pittsburg, Pa., and, the said witness being of sound mind and lawful age and having been by me duly sworn to testify the truth, the deposition was reduced to writing by me and signed by the witness in my presence.

I further certify that I am not of counsel for either of the parties to this cause or interested in the event of the same.

In testimony whereof I have hereunto set my hand and official seal this 27th day of June, 1884.

W. B. CORWIN,
Notary Public.

37 *Rebutting Evidence.*

Examination of witnesses and other evidence on behalf of complainant under the 67th rule in equity, as amended, pursuant to agreement of counsel, before W. B. Corwin, notary public and special examiner, at the office of Bakewell & Kerr, No. 110 Diamond street, Pittsburgh, Pa., beginning on September 16, 1885, at 10 o'clock a. m.

Present: Thomas B. Kerr, Esq., on part of complainant, and William D. Baldwin, Esq , on part of respondent.

JULIAN KENNEDY, being duly sworn, deposes and says:

Int. 1. State your name, age, residence, and occupation.

Ans. Julian Kennedy; age, 33 years; residence, Pittsburgh, Pa.; occupation, furnace manager.

Int. 2. How long have you been engaged in your present business?

Ans. About six years continuously now.

Int. 3. What furnaces have you had charge of during that time?

Ans. Edgar Thomson furnaces and the Lucy furnaces. I had charge of five furnaces at the Edgar Thomson for four years and two at the Lucy for the last two years. The five Edgar Thomson furnaces were all built under my charge.

Int. 4. What is the class of the Carnegie and Lucy furnaces?

Ans. The Edgar Thomson had one thirteen and four twenty-feet furnaces, the latter being eighty feet high and among the largest in the country. The Lucy furnaces are also twenty feet in diameter and eighty feet high, and are all fitted with modern applications.

Int. 5. State whether those furnaces are of the kind known as closed-breast furnaces.

Ans. They are.

Int. 6. What arrangement is used in those furnaces for discharging the cinder?

Ans. The cinder is discharged through a water-cooled block.

38 Int. 7. State whether or not they were operated by license under the Luermann patent.

Ans. They were.

Int. 8. Please describe the form of the Luermann cinder-discharge arrangement used in those furnaces.

Ans. We use a large conical iron block, cooled by water coil built in the well of the hearth. Inside of this is inserted a small conical iron block similarly cooled. In the small end of this is inserted a bronze water-cooled block, having an opening of from an inch and a quarter to an inch and three-quarters in diameter. This bronze

block is closed by an iron plug, which is withdrawn when it is desired to tap cinder.

Int. 9. Look at the sketch now shown you and state whether it represents the construction you have just described; and, if so, indicate the parts you have mentioned by letters of reference marked thereon.

Ans. It does; *a* shows the well of the hearth, *b* the largest water-cooled block, *c* the intermediate block, and *d* the small bronze block.

Int. 10. Please state whether you ever ran one of these furnaces at any time—and, if so, for how long a period—without the block *d*.

Ans. We have at various times run them without the block *d* for perhaps two or three or four days at a time.

Int. 11. State the reason for doing so.

Ans. We did this when the furnace was not working very well and the cinder not fluid enough to run well through the small block.

Int. 12. Did that occur when the furnace was running regularly, so far as the smelting operation was concerned?

Ans. Yes; the furnace was running regularly, but owing to being slightly cold or to variations in the material the cinder was not as fluid as we like to have it.

Int. 13. Were these irregularities in the smelting operation of frequent occurrence or only occasionally?

Ans. They were not of very frequent occurrence.

Int. 14. What was the size of the cinder-discharge opening on these occasions when the block *d* was not used?

Ans. About four and a half inches.

39 Int. 15. Please state whether you ever ran any of these furnaces at any time—and, if so, for how long—without the block *c*.

Ans. We have run on several occasions without it for from six to twenty-four hours or longer.

Int. 16. What was the occasion for this?

Ans. One cause was the accidental loss of the block by burning; at other times it was withdrawn when the furnace was working very irregularly, in order to remove the thick slag.

Int. 17. On such occasions did anything else come out of the furnace beside the slag?

Ans. Yes; we sometimes blew out considerable fuel and ore and limestone.

Int. 18. When you were working the furnaces without the block *d*, and also when you were working them without the blocks *c d*, did you flush the cinder in the same way as when you were working with the block *d*?

Ans. Yes; except that it was generally more trouble to stop the outlet, involving slacking down of the blowing engine.

Int. 19. What did you use to stop the cinder opening on these occasions?

Ans. Clay and fire-brick bats.

Int. 20. How did you open the cinder opening when you desired to flush on such occasions?

Ans. By driving an iron bar through the clay stopper.

Int. 21. What effect, if any, did the flow of cinder thus made in the clay and fire-brick stopping have upon the same?

Ans. It generally enlarged it considerably, allowing the escape of considerable hot gases and the blowing out of a good deal of hot coke.

Int. 22. What was the diameter of the opening when the block *c* was not used?

Ans. About sixteen inches.

Int. 23. You have given your experience as furnace manager as being confined to the past six years. Had you any experience prior to that time in connection with blast furnaces; and, if so, in what capacity and for what length of time?

40 Ans. I was for one year employed as a draughtsman and one year as engineer and another year in the office—that is *that is*, from 1869 to 1872. Then in 1876 and 1878 about one year's experience as assistant manager and manager. That is all the actual experience; in the meantime I was studying with reference to furnaces at school.

Int. 24. Please state how generally closed-breast furnaces having water-cooled cinder outlet are in use in this country.

Ans. I think they are used in nine-tenths of what we call the better class of furnaces, making from eighty tons upwards a day.

Int. 25. Upon what sources of information or knowledge do you base your last answer?

Ans. From observation, from conversation with furnace engineers, and from drawings and descriptions in the technical journals.

Int. 26. Can you state what construction was used prior to the introduction of closed breasts?

Ans. The general construction was a cylindrical hearth with an opening in front called a fore hearth closed by a dam, the wall of the hearth above the fore hearth being built thin, protected by a water-cooled casting called a trap, the opening at the top of the fore hearth being of considerable size and closed during the regular working of the furnace by a heavy plate held down against the pressure of the blast, either by loading with weights or fastening some kind of a prop above it.

Int. 27. State whether or not this form of furnace is distinguished by any name from the form of furnace known as closed fronts; and, if so, what?

Ans. It is called the open-front furnace.

Cross-examination by W. D. BALDWIN, Esq., subject to objections, as follows: It having been agreed that said objections should be stated at the close of direct examination with the same force and effect as if made at the time the questions were asked or answered, the entire deposition is objected to as irrelevant and immaterial to any issue raised by the pleading and as not rebuttal.

(Counsel for complainant offers in evidence the sketch
41 referred to by the witness in his deposition, which is marked "Complainant's Exhibit Kennedy.")

X Int. 28. When was the license granted referred to in your seventh answer?

Ans. The first license at Edgar Thomson was granted, I think, in 1879; the others at various times afterwards. I can't recollect. At the Lucy furnaces I don't remember the dates; they were granted before I took charge of them.

X Int. 29. Was the consideration for those licenses a fixed sum or an annual royalty?

(Objected to as incompetent.)

Ans. It was a fixed sum.

X Int. 30. How often, on an average, was the plug withdrawn from the bronze block *d* to tap the cinder, as stated in your eighth answer?

Ans. About sixteen times in twenty-four hours.

X Int. 31. About how long at a time?

Ans. Perhaps fifteen or twenty minutes.

X Int. 32. What fuel was used in the furnaces of which you were manager during the operations about which you have testified?

Ans. Mostly coke; for a short time a mixture of coke and anthracite coal.

X Int. 33. What flux did you use?

Ans. Limestone.

X Int. 34. State the character of the flux as to purity or as mixed with other material, such as slate, for instance?

Ans. The flux was generally of pretty pure limestone, containing carbonate of lime, but sometimes we used stone containing as high as ten per cent. of silica and six or eight of alumina; also used at times stone containing considerable magnesia.

X Int. 35. Did you ever encounter slate in your fuel or flux under circumstance above mentioned?

Ans. We generally had a little slate in the fuel.

X Int. 36. How did that qualify or affect the working of the furnaces?

Ans. It had no appreciable effect on the working of the fur-
42 nace, except that it increases the ash and reduces the carbon in the coke, requiring more limestone.

X Int. 37. What proportion of furnaces at work in this country do you understand to make over eighty tons of iron a day.

Ans. I can't answer that very intelligently.

X Int. 38. What number of such furnaces do you know of -our own knowledge to exist?

Ans. About forty furnaces.

X Int. 39. Wherein, if in any respect, do you understand the operation of the furnaces you have described to differ when the blocks *c* and *d* are in place and when they are removed, as you have described?

Ans. When the blocks *c* and *d* are in place the tapping hole is easily closed without reducing the pressure of blast in the furnace, but when they are out the clay stopper of the block *b* is likely to be fluxed away by the slag flowing through and enlarging the opening from the size of the bar—say one and three-quarter inches—to a size of four or five inches or more, allowing fuel to be blown out and rendering it necessary to reduce the blast so that the furnacemen can stop the hole again. This causes irregular working to a certain extent, also a loss of time, loss of fuel and of hot gases.

JULIAN KENNEDY.

GEORGE ASMUS recalled for rebuttal:

Int. 37. What is the effect of the chilling up of the fore hearth in an open-front furnace?

Ans. Difficulty of getting out the iron and cinder.

Int. 38. What effect, if any, would it have on the smelting process or operation of the furnace?

Ans. It would be necessary to remove that chilled substance from that portion of the furnace called fore hearth. The running of the blast would have to be interrupted until the proper outlets for cinder and iron are opened again; else cinder and iron would rise to the tuyeres and above them, destroying the tuyeres. This will
43 happen when the chill is sufficiently complete that cinder and iron cannot be tapped through the ordinary opening.

Int. 39. What steps are necessary to effect the tapping of the iron through a chilled fore hearth?

Ans. Extremely hard working with chisels and bars to get through the tough substances which fill the fore hearth.

Int. 40. In the Defendant's Exhibit Grittinger Sketch No. 2 the iron notch is shown as provided with an opening reaching in to the hearth of the furnace through the chilled cinder and stock; please state whether that channel would remain open during the interval between the tappings of the iron.

Ans. On that sketch the iron tap and the cinder tap are drawn as open. I cannot tell whether they are opened artificially or not. It may or it may not.

Int. 41. What would be the effect of permitting a chill to remain in the fore hearth?

Ans. It would endanger the working of the furnace altogether.

Int. 42. How?

Ans. Because so long as the cause of the chill continues, whatever that cause may be, the chill will grow into the furnace, will fill up the whole hearth, and necessitate finally the blowing out of the furnace.

Int. 43. How does the extension of the chill into the hearth of the furnace affect the operation of the iron notch?

Ans. The distance between the outside of the iron notch and the point in the furnace where the iron is in a molten state is getting greater, and it becomes more and more difficult to keep the notch open.

Int. 44. What time is required to open the iron notch for the purpose of tapping in such case?

Ans. From one hour to twenty-four hours.

Int. 45. While this time is elapsing what is the furnace doing?

Ans. Standing still from the moment that there is no more room in the hearth to receive any more iron or cinder.

Int. 46. What moment is that?

Ans. When the cinder is up to the tuyeres; the cinder tap
44 can't be left open because the men are working at the iron notch.

Int. 47. In case the furnace should be stopped for the reason last given what would be the effect of the stoppage?

Ans. A further increase of difficulties on account of the half-molten stock above the tuyeres cooling off.

Int. 48. What effect has the operation of melting out a chill upon the character of the product, if any, and what does such operation necessitate in reference to the charge?

Ans. The smelting out of a chill is only possible by doing away with the causes which originate the chill, and those causes may be of various kinds, such as water in the furnace or not enough fuel or too little flux or a combination of the whole. If the wrong charge was the cause the charge would be altered in such a way as to make a cinder which is able to dissolve the solid masses in the hearth. More coal has to be used to produce sufficient temperature to remedy the evil. Very often all there means do not have effect, and the result is a salamander, which puts a stop to the operation. In this case the output is stopped altogether. Under all circumstances the output is lessened and the quality of iron will be different from that which was intended to be produced.

Int. 49. Is there any more liability of the occurrence of a chill in one of the two classes of furnaces known as open and closed fronts than there is in the other?

Ans. Yes; there is a great difference. The open front is more apt to be chilled than the closed front.

Int. 50. For what reason?

Ans. The fore hearth, which constitutes an essential part of the open-front hearth, is an offset of the hearth itself—a kind of a box extending outwards—and in consequence the coldest part of the hearth. Any chill that may occur will show itself first in the fore hearth.

Int. 51. What is necessary to prevent the occurrence of chills in an open-front furnace?

Ans. You have to open the top of the fore hearth frequently and dig out the matter which fills it.

Int. 52. What is the character of the work necessary in cleaning out the fore hearth?

45 Ans. It is the hardest work about the blast furnaces on account of the matter spoken of issuing red hot and in a half-molten state, difficult to remove on account of its toughness and temperature.

Int. 53. Who introduced the Luermann system of closed-breast furnaces into the United States?

Ans. I did.

Int. 54. What knowledge did you have at that time of the furnaces which were in operation in the United States?

Ans. Only the general knowledge that the furnaces in the United States did not differ in any important way from those in the old world.

Int. 55. Did you visit any of these furnaces?

Ans. Immediately after the patent was issued I visited the principal iron centers in the United States and explained, after having seen the blast furnaces, Lurmann's patent to the owners.

Int. 56. What construction did you find in those furnaces at that time?

Ans. Long open fronts throughout.

Int. 57. What proportion of the furnaces in use prior to 1870 did you visit?

Ans. I saw the most important furnaces, but what proportion of those in use I could not say.

Int. 58. Can you state what proportion of furnaces in the United States were using or were constructed with closed breasts and water-cooled cinder outlets in the year 1884?

Ans. Perhaps half. A great many, however, did not work under the Luermann patent, having made some sort of an arrangement which made the furnaces working with closed fronts and water-cooled cinder outlet in a different shape from Luermann's invention shows, trying to evade in this way paying the patent fees.

Adjourned to Sept. 17, at 9.30 p. m.

PITTSBURGH, *Sept.* 17, 1885.

Met pursuant to adjournment.

Present: Counsel as before.

Witness desires to change his last answer by changing the word "invention" to "drawing." I desire to add that the
46 large furnaces which are fitted up according to modern science are all running, with a few exceptions, under license sold to them by me under the Luermann patent.

Int. 59. In your list of licenses given in your former deposition you name the furnaces of Robert H. Coleman, at Lebanon, Pa. Do you know what stock is used in those furnaces and whether it differs at all from the stock used by the defendants?

Ans. It is the same as far as I know or have seen there.

Int. 60. Please describe the construction of the cinder notch in the Robert H. Coleman furnaces, at Lebanon.

Ans. They have closed fronts and tap the cinder directly from the hearth through a small cinder notch with about one and a half inch opening. This notch or block is set in a larger conical casting. The cinder block and this casting are cooled by water.

Int. 61. Is there any provision in the Robert H. Coleman furnaces

for getting rid of what the defendant calls "bone," in case any should remain unsmelted?

Ans. I do not know what is meant by bones in stock, but I suppose it is matter which can't be smelted. Provision to get rid of such matter is made in the furnaces in question; is made in all Luermann furnaces, as clearly given in the description of the invention in the patent. The cinder block is in such cases slipped out, a larger opening being accomplished by this, through which such matter can be removed. In the patent drawing this opening is protected by the water-cooled plate C. At the Colebrook furnaces, which is the name of the Robert H. Coleman furnaces, at Lebanon, the conical water-cooled casting spoken of takes the place of plate C. It holds the cinder block and serves as a guard in case the cinder block is taken out.

Int. 62. How would such unfused matter be removed in case the furnace was worked without the cinder block?

Ans. The larger hole is filled up with clay and sand, and when cinder is tapped a hole is dug through such sand wide enough to remove the stuff in question. It is blown out with the cinder.

47 Int. 63. Did you ever know any of the furnaces which have been licensed by you and which use the Luermann improvement to be operated at any time without the cinder block; and, if so, for how long a period and how frequently?

Ans. Yes; I know several. For instance, the furnaces of the Jackson Iron Company, which are charcoal furnaces, are operated for at least twelve years now with closed fronts, without a cinder block proper. The cinder is tapped through a water-cooled, saddle-shaped casting about 18 inches long and 12 inches wide, which casting is set into the wall of the furnace.

Int. 64. The question is broad enough to include occasional omission of the cinder block. What is the practice among the users of Luermann furnaces with regard to that?

Ans. They use cinder blocks with holes as small as possible in ordinary work—that is, when the furnace is in good condition. Whenever the furnace is out of order they take the cinder block out and tap for awhile through the larger opening left for that purpose.

Int. 65. What do you mean by the furnace being out of order?

Ans. The furnace is out of order in this sense, whenever the cinder is not fluid enough to pass through a hole smaller than about three inches. Some furnaces make constantly sluggish cinder and use cinder blocks with holes from two to three inches wide, while the standard size is from an inch and a quarter to an inch and a half throughout the furnaces in the country.

Inter. 66. What is a tymp?

Ans. A tymp is the wall above the fore hearth, being a part of the walls surrounding the main hearth of a blast furnace with an open front. The tymp is protected by an iron plate called the tymp plate, which in many cases is cooled with water. It is set against the tymp vertically or at a slight angle, and has on its lower end a horizontal prolongation reaching under the arch, which forms the

under edge of the tymp. This prolongation keeps the so-called stopper from smelting away. The stopper reaches downwards and is a mass of clay, which forms the intercepting trap essential to a furnace with an open front. The cinder runs out under the stopper, and its outflow is not through the water-cooled plate
48 called tymp plate. It rises then to the top of the dam and flows away.

Int. 67. Look at the Defendant's "Exhibit Cinder Flush" and state whether the water-cooled plate through which the cinder flows is a tymp plate.

Ans. No; it is not a tymp plate, because there is not a tymp as there is no fore hearth.

Int. 68. Is there any difference, so far as the discharge of the cinder is concerned, between the discharge of cinder where a tymp plate is used and where a construction like the defendant's is used?

Ans. There is a great difference. In the model cinder flush the cinder is tapped directly from the furnace and runs by coming out through the furnace wall through water-cooled plate, while in the other the cinder runs under the intercepting trap into the fore hearth, and from here away from the furnace. It shows a closed front where the cinder is tapped directly from the hearth through an opening cooled by water.

Int. 69. What is the main purpose of the water cooling in the Luermann invention?

Ans. To prevent the smelting away of the surroundings of the cinder outlet by the passing slag.

Int. 70. Please state what is necessary to the use of a closed-breast furnace for the manufacture of iron as generally practiced at the present day.

Ans. A cinder tap protected by water cooling.

Int. 71. For what reason is it necessary?

Ans. The cinder dissolves the material out of which the furnace is built in passing through the necessary cinder outlet. It widens it constantly if not checked by water-cooled guards. The furnace would become impracticable after a short time.

Inter. 72. Please state whether or not any other provision than the water-cooled plate through which the cinder is tapped in the defendant's furnace is necessary to preserve the limits of the cinder-discharge opening.

Ans. Not necessary.

Int. 73. What was your experience with reference to the introduction of the Luermann invention?

49 Ans. Most people laughed at it, and the difficulty to induce anybody to adopt the new plan was extremely great. The principal objection was that the stock which was shovelled out every day from the fore hearth could not be taken out any more, and the furnace was closed. This stock was considered by most furnacemen infusible dead matter, which had to be removed. It was difficult to make them understand that it only became dead matter while shut up in the outside cold box called the fore hearth; that it was nothing but cold and half-smolten ore, beyond the reach of the blast,

becoming so in fact dead matter, which had to be removed. They could not see that if the furnace had no fore hearth everything that dropped down upon the surface of the molten iron would rise, would be under the influence of the smelting heat, and would either smelt or burn. So the furnace keeps itself clear—it becomes, in fact, self-acting—and all the loss of time and fuel and the great amount of work is done away with as soon as the fore hearth is abandoned. A few of our leading blast-furnaces men, however, saw the correctness of this argument. They allowed me to change their furnaces from the old to the new system while in blast. In some instances they abandoned it again for a time because the workingmen were badly opposed to the new plan. In the Lehigh valley, for instance, by old practice, all the coal shoveled out of the furnaces belonged to the furnace laborers, and they lost a great benefit as soon as the coal was allowed to burn up, for the purpose for which it was thrown into the funnel head. Still, some of the furnaces kept on working well, and little by little the truth found its way throughout, until now the revolution is a complete fact, undisputed by any of our leading blast-furnace men.

Int. 74. What has been your principal business since 1867?

Ans. Converting the blast furnaces in the United States from open-front furnaces to closed-front furnaces, according to Luermann's patent.

Int. 75. What was your reason for applying for and obtaining a reissue of this patent?

Ans. To make the meaning of the whole invention as clear as possible to all who were concerned.

Int. 76. State whether any furnaces having closed breasts and water-cooled cinder outlets were put in use before your application for reissue which were not licensed by you.

Ans. None to my knowledge.

Int. 77. State why you did not apply for a reissue sooner than you did.

Ans. In arranging a number of furnaces I found that the same differed more or less in the construction, and I had to adopt my construction according to the circumstances. This made it necessary to give the construction quite different shapes, so the main points always remain the same. This experience caused me, in order to prevent mistakes, to find a formula which expresses the spirit of the invention in the clearest way possible and which flows plainly from the technical description given in the original patent. The experience and the reasoning deriving from it took up some time.

Int. 78. Did you know you were entitled to apply for a reissue of the patent?

Ans. I learned so through my patent lawyers, Van Santvoord & Hauff, in New York. I learned this about a year after the first patent was taken out.

Int. 79. In adapting the invention to different constructions and circumstances of furnaces, did you have any assistance or suggestion from any other person?

Ans. From nobody but Mr. Luermann, who sent me quite a num-

ber of printed drawings showing the ways he altered the furnaces in Germany. They were printed with descriptions in three languages, French, English, and German, and I made use of the same here as well as in England and France, where I arranged the first furnaces upon Luermann's requesting me to do so.

Int. 80. Why did you not have the reissue papers executed by Mr. Luermann?

Ans. My legal advisers told me it was not necessary.

Int. 81. Do you know where your licensees got the information as to the ability to use the invention without the presence of the cinder block D?

Ans. They got it from me.

51 (Cross-examined by counsel for defendant without waiver of objections, which are now entered by agreement with the same force and effect as if entered at the time the questions and answers were given.)

(The deposition is objected to generally as irrelevant and immaterial and as incompetent on rebuttal. Questions and answers from 37 to 52, both inclusive, are objected to as incompetent on rebuttal, being simply a reiteration in substance of witness' examination-in-chief. Questions and answers 59 to 62, both inclusive, are objected to on the ground of incompetency, irrelevancy, and immateriality, Robert H. Coleman being neither party nor privy with this defendant or any of his associates, and the matter relating to a construction of furnace different from that used by the defendant.)

X Int. 82. In answer 46 you say, When the cinder is up to the tuyeres the cinder tap can't be left open, because the men are working at the iron notch. Would that be the case where the two openings were in different parts of the furnace, so that one would not be vertically over the other?

Ans. No; it would not; but the furnace I spoke of is one of those where they always had them together.

X Int. 83. What do you mean by "water in the furnace," as stated in answer 48?

Ans. A leaking tuyere, for instance, would cause water in the furnace and produce a chill.

X Int. 84. Is such an accident as that mentioned in your last answer more likely to occur in an open-front furnace than in one with a closed front?

Ans. No; but the consequence is a different one.

X Int. 85. Suppose such a leak to occur in the back tuyere of a furnace farthest from the cinder notch, what difference in consequence would ensue?

Ans. That part of the chill which is in the fore hearth cannot occur in a closed-front furnace, and it will be, at any rate, less work to get over it than when hearth and fore hearth are chilled up, the hearth being hot and kept hot by the running down of the fluid iron, the fore hearth being outside of the heating influence of the

52 smelting process. Most chills occur in the fore hearth, and

when the cause is known the same will be stopped, but the fore hearth will have to be dug out.

X Int. 86. How long would it take a leak in a tuyere, so slight as not to produce an explosion, to chill the fore hearth of a furnace thirteen feet in diameter at the boshes?

Ans. I do not know.

X Int. 87. When was the Robert H. Coleman license granted, as mentioned in the 59th question?

Ans. About three or four years ago, when the furnaces were built, or shortly after that.

X Int. 88. Was a fixed sum or a continuous license fee paid for the use of that furnace?

Ans. A fixed sum.

X Int. 89. Please answer the same question with regard to the Jackson Iron Company furnaces mentioned in answer 63.

Ans. A fixed sum.

X Int. 90. In Int. 72 you are asked whether any other provision than the water-cooled plate through which the cinder is tapped in the defendant's furnace is necessary to preserve the limits of the cinder-discharge opening, and you answered not necessary. Please refer to the exhibit showing the construction in your mind when you made that answer.

Ans. This "Exhibit Cinder Flush." A further provision is not necessary, though this cooling is not quite as complete as it might be made.

X Int. 91. Grittinger answer 8, page 24 defendant's record, states the opening in the casting of the furnace represented by that exhibit to be fourteen by fourteen inches reduced to ten by ten or less by a clay packing. Was your answer to the 72d Int. made with this understanding of the construction of that furnace?

Ans. Yes. The water-cooled upright plate through which the cinder is tapped prevents the melting away of the furnace wall, so keeping the limits of that opening intact.

X Int. 92. As a matter of fact, do not the water-cooled plates wear out in time and have to be replaced?

Ans. Sometimes they do, and sometimes they don't. There
53 is no wear and tear on them, but sometimes they crack the very first day they are put in, and then they have to be replaced.

X Int. 93. In your 73d answer you say "this stock was considered by most furnacemen infusible dead matter which had to be removed. It was difficult to make them understand that it only became dead matter while shut up in the outside cold box called the fore hearth; that it was nothing but cold and half-smolten ore beyond the reach of the blast, becoming so, in fact, dead matter which had to be removed." Do you mean to be understood as saying that as late as 1867 the expert furnace managers of this country did not understand the constituent material they were manipulating in the blast furnace and the results produced by such manipulation?

Ans. I did not say that all of the leading furnacemen had such an idea, else nobody would have allowed me to shut up their fur-

nace fronts, but it was a common superstition among the melters, who used to run the furnaces at that time pretty independently of scientific influences, which have since then taken the lead in the blast-furnace business. At any rate, the remark in question was made to me by these men, who tried everything to prevent a change being made at their furnaces.

I may add that the idea about dead matter in the stock, bone, &c., is still not quite abandoned. It is in such places overcome as soon as proper temperature is given to the furnaces, when most of the hitherto infusible matter will run out dissolved in the cinder. There is matter which is with difficulty consumed, and for this, under all circumstances, provision ought to be made to have it taken out of the furnace without much disturbance.

X Int. 94. Do not closed-breast furnaces operated under what you call the Luerrmann system sometimes become so much obstructed with infusible dead matter, such as you have mentioned, as to require the removal of the cinder block in order to clear the furnaces of such dead matter?

Ans. I have not seen one instance of that kind, but very frequently I have seen cinder not fluid enough to be able to run through a small hole in a cinder block, and then I have seen the cinder block taken out and the cinder passed through an opening
54 wide enough for its fluidity. It may, however, occur that other matter, as coal-dust, gases in the furnace, is covered by cinder and protected against combustion. Such obstructions ought to be removed through a larger hole, of course, but these occurrences are not the rule, they are but accidental.

X Int. 95. Is unburnt coal which has passed through the furnace one of the substances ordinarily shoveled out of a fore hearth?

Ans. Yes; especially in anthracite furnaces.

X Int. 96. Does it come out mixed with other substances or separate?

Ans. In coke furnaces it is coke more or less impregnated with cinder; in anthracite furnaces it is lumps of anthracite.

X Int. 97. What kind of mistakes did you expect to prevent by finding a formula to express the spirit of the Luermann invention, as stated in your answer 77?

Ans. That difference in shape might be taken for a different thing.

Redirect:

Int. 98. Have you examined the following paper exhibits put in evidence by the defendants, namely, Exhibits Kerl, Merle, Percy, Bedson, Dalton, Bryant, and Stileman & Ellis? And, if so, please state whether you have found therein, either described or claimed, the invention claimed in reissue No. 3204.

Ans. I have examined the papers and did not find anything like Luermann's patented improvement. Kerl refers to a furnace for melting tin; nothing is said about cooling the cinder outlet in any way. Merle shows a fancy sketch of an impossible furnace. The inventor introduces on one side of the furnace gases and chemicals

into the hearth. Nothing is said about the cinder outlet as being separate from the outlet for the iron.

Percy's sketch shows the lower part of an open-front blast furnace and the way to protect the sides of the furnace by water-cooled castings. Nothing is said beside this. It shows a style of water-cooled tuyeres for the blast.

The Bedson drawing does not show a ground plan, and it
55 is impossible to see whether it refers to a closed or an open front. Nothing is said about the mode of discharging the cinder.

The Dalton drawing shows no ground plan, and it is impossible to see whether it refers to an open or closed front. The cinder outlet is marked, but nothing is said that it should be cooled by water.

The Bryant shows an open front, where the crucible is protected by water boxes. Nothing is said about the mode of discharging cinder.

Stileman & Ellis show a cupola furnace, not for making iron, but for smelting scrap. Cinder and iron are run out together through a hole near the bottom into a box, where the iron may accumulate and the cinder run off near the top. The whole has no reference to a blast furnace and refers only to the accumulating box which is outside of the furnace.

Int. 99. State whether, in your opinion, a person skilled in the art could, without other knowledge or information, construct a Luermann furnace from anything contained in these exhibits.

Ans. He could decidedly not.

Int. 100. Please state what relation that part of the specification of the Luermann patent which relates to the method of controlling the discharge of slag, forming the subject-matter of the 7th claim, bears to the Luermann invention.

Ans. It is one of the finer points, which comes in as inferior substance to the whole.

Int. 101. Under what circumstances is that method practiced and of utility?

Ans. Wherever very lean ores are smelted and consequently very large amounts of cinder are made. In this case it is found highly convenient to run the cinder all the time from one iron tap to another. In order to be able to do this the size of the cinder hole is regulated by the amount of water flowing through the cinder block. This does away with the labor, which is indispensable for removing the chilled cinder which fills the cinder channel
56 between the furnace and the place where the cinder is run into cars every time, after cinder is flushed in the ordinary way.

Questions 98 to 101 were asked after the cross-examination of the witness by consent, and the objections as to materiality, relevancy, and rebuttal are not made against them.

GEORGE ASMUS.

(I desire to correct my answer 22 by striking out the Scranton iron works from the list of licensees. It was put in by mistake.)

Adjourned to 2.30 p. m.

Met 2.30 p. m.

ROBERT C. PORTER, being duly sworn, deposes and says:

Int. 1. State your name, age, residence, and occupation.

Ans. Robert C. Porter; age, 41 years; residence, Pittsburgh, Pa.; occupation, furnace manager of the Soho furnace, Pittsburgh (Moorhead, McCleane & Co.).

Int. 2. How long have you been engaged in blast-furnacing?

Ans. Since 1866.

Int. 3. What kind of a furnace did you first operate?

Ans. The open front.

Int. 4. Did you ever have the fore hearth fill up?

Ans. Yes.

Int. 5. What was the effect of that chilling upon the work of tapping the iron?

Ans. It interfered with the tapping of the iron and made trouble; it made delay in drilling for the iron.

Int. 6. Could the furnace be run right along during such delay?

Ans. It frequently happened when we had the open fronts that with a chill in the hearth or crucible that we cast over the dam and in that way continued to run the furnace.

Int. 7. Could you continue to use the furnace without cleaning out the fore hearth by casting over the dam?

Ans. We could continue to use the furnace, but we con-
57 sidered the furnace in very bad shape when we were compelled to cast over the dam.

Int. 8. What was necessary to be done to remedy it?

Ans. We always made it a point to either cut out the hearth, if possible, and if we could not succeed in cutting out the hearth to blow out the furnace.

Int. 9. State whether there was any more liability of a chill occurring in one of two classes of furnaces known as open or closed—one than in the other—and, if so, which.

Ans. Chills were very frequent in the open-hearth furnace. The open hearth was the most liable.

Int. 10. What was the cause of this greater liability?

Ans. What we used to call the long-neck furnaces formed a reservoir for dead material, and especially in running on foundry iron or Bessemer iron and the finer grades of iron, but after these necks were shortened up so that the point that the iron and cinder was discharged out from was brought nearer to the center of the furnace we did not have any trouble with those chills.

Int. 11. When was this change made in furnaces, and to whom was it due?

Ans. I think it was along in 1868 or 1869—I was at Haselton, Ohio—that I heard the idea of Mr. Luermann doing away with these

long necks in blast furnaces. We pulled out our dam plate at Haselton and cut the jambs out and set the dam-plate beneath the tymp plate, leaving a space of about six inches between tymp plate and dam-plate. The cinder was discharged through the stopper under the tymp plate. This was done on No. 1 furnace. The idea was so new that we were afraid to attempt it on both furnaces and attempted it on one furnace as an experiment. This improvement increased the output of the furnaces and did away with a great deal of hard labor, and did away with long-neck furnaces in the Mahoning valley. My understanding at the time was that the improvement was due to Mr. Luermann.

Int. 12. Did you obtain a license for the Haselton furnace from Mr. Asmus?

Ans. Not at that time. I don't know whether they ever did. I left there a year or so afterwards.

58 Int. 13. Can you state upon what plan the leading furnaces of the country generally are built?

Ans. Closed-front furnaces in all the modern plants—that is, the best improved modern furnaces.

Int. 14. What kind of a cinder outlet have they?

Ans. They are not all alike, but the cinder outlet is protected by water. Three cones is the common style in use.

Int. 15. What kind of a cinder outlet did you use at the Soho furnace?

Ans. We had three cones. If the furnace is in good working condition we use all three. If not in good working condition we take out one and sometimes two—that is, the inside cones.

Int. 16. What is the diameter of the hole in the inside cone?

Ans. I have two sizes; one is inch and a half and the other two inches on the inside cone.

Int. 17. What is the diameter of the opening in the second cone?

Ans. Seven inches in diameter.

Int. 18. What is the diameter in the opening of the outside cone?

Ans. Fifteen inches inside and thirty inches outside.

Int. 19. State whether or not cones as used in your furnace are arranged in the manner shown in Complainant's "Exhibit Kennedy"?

Ans. Just the same; they are put in just the same; the sizes are not just the same.

Int. 20. How long a time have you run the furnace without the smallest cone?

Ans. We frequently run two or three days if the furnace is not working properly.

Int. 21. How long have you run without the two smallest cones?

Ans. Never run without the two inside cones except the furnace is working badly. I always blow in without the two inside cones.

59 Int. 22. Is there any difference in the operation of flushing

cinder when you do not use the small cinder block than when you do use it?

Ans. There is a difference. When our cinder is done flowing we find it necessary to slack the blast to stop the cinder notch.

Int. 23. With this exception are the operations the same?

Ans. Just the same.

Int. 24. Do any solid matters ever come out with the slag when you are tapping through the large hole?

Ans. This is the object of taking out the two inside blocks, to get rid of troublesome material in the furnace.

Int. 25. Are these irregularities in the smelting operation which necessitate the removal of the small block of frequent occurrence in blast furnaces like the Soho?

Ans. No; they are not, unless we stop to make repairs or slipping in the furnace.

Int. 26. How much of a change was there in the output of the Haselton furnace?

Ans. The output was from 18 to 20 tons a day previous to this change; afterwards the furnace ran from 25 to 30 tons a day.

(Defendant's counsel objects to this deposition as irrelevant and immaterial and not proper rebuttal and declines cross-examination.)

R. C. PORTER.

Adjourned to meet on notice.

60 Testimony of witnesses and other evidence taken on behalf of complainant pursuant to notice, before W. B. Corwin, notary public and special examiner, at the office of Bakewell & Kerr, No. 110 Diamond street, Pittsburgh, Pa., beginning September 29, 1885, at 10 o'clock a. m.

Present: Thomas B. Kerr, on behalf of complainant, and William D. Baldwin, Esq., on behalf of defendants.

IGNATIUS HAHN, being duly sworn, deposes and says:

Int. 1. State your name, age, residence, and occupation.

Ans. Ignatius Hahn; age, 47 years; residence, Sharpsburgh, Pa.; occupation, engineer and metallurgist.

Int. 2. What experience, if any, have you had in blast-furnace practice?

Ans. After studying inorganic chemistry and metallurgy for about three years I visited most every year since for several weeks at a time iron and steel districts, more especially in Europe and in this country. I also was frequently consulted by blast-furnace owners and ironmen on the proper charges for the production of several grades of pig-iron, ananalyzed the ores, fluxes, and fuels, as well as the cinders and iron produced from the furnaces, and directed them for the production of the several grades at the blast furnaces.

Int. 3. Did you ever have charge of a blast furnace?

Ans. For about two years I was engaged by the Lackawanna Iron and Coal Company to investigate mineral lands that they owned and those in adjoining counties and States with a view of finding

ores suitable for the production of Bessemer pig-iron, which I analyzed and made experiments at their blast furnaces, at Scranton, where the charges and the furnace were operated according to my direction to prove that the ores which I designated as fit for Bessemer pig would actually produce such iron. I did not have practical charge. I gave my directions to the general manager, but I observed every day that they were executed, and if everything was not as I considered it should be I called their attention to such de-
61 fects to remedy them. I also made pig-iron of various other qualities during that time for mill and foundry purposes.

Int. 4. What was the construction of the Lackawanna furnaces you have just referred to?

Ans. There were five furnaces, every one of which was provided with a fore hearth, through which cinder and iron had been tapped?

Int. 5. Are you acquainted with the Luermann furnace?

Ans. Yes, sir.

Int. 6. What is the difference between it and the fore-hearth furnaces you have spoken of?

Ans. While in the ordinary furnaces, such as have been in use at such time, the blast furnace proper had an adjunct on the outside thereof consisting of a box of any suitable shape, which stood in communication with the interior of the furnace whence metal and cinder first passed through underneath what in such furnaces is called a tymp, and there remained until sufficient quantity had accumulated therein for tapping off the cinder over the dam and subsequently the iron from a hole at a lower part of the dam, the fore hearth being exposed to constant cooling by the atmosphere, which is transferred back*ed* towards the hearth proper, in contrast with this complicated arrangement the Luermann patent consists in dispensing entirely with tymp, fore hearth, and wall stone, carrying the surrounding walls of the hearth directly clear down to the bottom stone without any interruption, and then have a water-cooled opening at any convenient height above the bottom stone for tapping the cinder directly from the hearth of the furnace and likewise the iron directly from the hearth.

Int. 7. What advantage, if any, is there in the Luermann furnace over the old open-front furnace?

Ans. In the open-front furnace, owing to the frequent necessity of removing the cinder through those large openings from the fore hearth, the interior becomes more cool, and in consequence thereof leads to more frequent accumulations, to remove which the dam-plate must frequently be opened for working out those obstructions, during which working the blast in all cases must at least
62 be slackened and mostly even stopped for a great length of time until the hearth is cleaned again. In consequence of such slackening or stoppage of the blast combustion is interrupted in the interior of the furnace, whereby a larger part of the furnace becomes considerably cooled and absorbs a greater quantity of fuel and time to subsequently restore the same heat at which the furnace works best and which existed before commencing cleaning. Thus it is safe to say that not only the time actually absorbed in work-

ing—that is, cleaning out—the fore hearth is lost, but as much again until the furnace comes again to that temperature that existed before. Again, frequently it occurs that the flame and blast passing out through underneath the tymp further reduce the heat in the furnace and annoy attendants by the heat of the flame and the usual bad smell of the gases issuing from the furnace. A further disadvantage of this arrangement consists in the rapid destruction of the tymp and wall stone, the renewal of which again absorbs time and retards the operation of the furnace. Inasmuch as Luermann's invention dispenses with tymp, fore hearth, and the damstone, all the disadvantages enumerated before as existing in the old-style furnace with fore hearth are readily overcome, and as a result thereof the production of the furnace is considerably increased, the labor less tiresome, and a greatly reduced amount of repairs, as all parts have a longer duration and no heat lost. The furnace works better and more regularly.

Int. 8. Are you familiar with the construction of any blast furnaces at the present time?

Ans. I am, and have repeatedly designed the latest improvements for blast furnaces for remodeling existing blast furnaces.

Int. 9. Please state what construction is in use in the furnaces known to you at the present time.

Ans. The best style of furnaces now in use generally employ Luermann's improvements, but there are still others which adhere to the old fore hearth and its necessary tymp and wall stone.

Int. 10. Which construction is in the more general use to your knowledge?

Ans. I think the old style with fore hearth constitutes the
63 larger number of furnaces at the present day, notwithstanding that Luermann's improvements give so very satisfactory results in saving of labor and repairs as well as fuel and greater production of pig-iron.

Int. 11. What is the case with larger furnaces known to you?

Ans. The largest and most economically working blast furnaces of the present day are supplied almost without exception with Luermann's improvements.

Int. 12. Are you familiar with Luermann's original patent No. 70447?

Ans. Yes, sir.

Int. 13. What do you understand to be the main improvement described in that patent?

Ans. The main improvement is to dispense with the tymp, fore hearth, and wall stone, close the breast entirely, and at a suitable height above the bottom stone provide a water-cooled opening for tapping the cinder and removing whatever obstructions there may be in the furnace.

Int. 14. What opening or openings are described for removing the slag?

Ans. There are several openings, one of which is used while the furnace is in proper working order, the other, after the removal of the casting with the just-mentioned opening, being resorted to only

at such times when the furnace is working irregularly by whatever cause it may have been produced, and then any obstructions, such as only partly smelted ores or fuel or dust, may be worked out through that larger opening until the furnace operating has been righted again or corrected, and then the smaller opening is by preference again applied.

Int. 15. State whether or not either or both of these openings are water-cooled.

Ans. They are both water-cooled.

Int. 16. How?

Ans. By circulation of water through pipes in the separate boxes containing the opening, and in either case the limit of the opening is perfectly preserved by such cooling.

Int. 17. In what is that water circulation contained when the smaller opening is used, and in what is it contained when the larger opening is used?

64 Ans. When the smaller opening is used the water-cooling arrangement is circulating along and around the hole through which the cinder is run, while in the larger opening it only exists part of the way of that opening or may be extended inwards.

Int. 18. What is the name of the part through which the water circulation is when the smaller opening is used?

Ans. In Luermann's patent he calls the casting with the smaller opening a cinder block, D, while the place where the larger opening is just a mere plate or box cooled by water and lettered in the patent as C.

Int. 19. Is that plate C a tymp plate?

Ans. It cannot be called a tymp plate, because there is no tymp, which only exists in connection with a fore hearth. The principal invention of Luerman is to dispense with tymp and fore hearth and apply instead thereof a water-cooled opening for removal of the cinder and occasionally also obstructions.

Int. 20. What relation has the method of controlling the flow of cinder, described by Luermann, by means of regulating the flow of water through the cinder block to the main idea expressed in his patent?

Ans. Mr. Luermann says that while the furnace is in the proper working operation he prefers to employ the cinder block D, the discharge hole through which is sufficiently small that the flow of the cinder may, if desired, be regulated by the passage of more or less water in a given time through that cinder block. If the furnace is not working properly—that is to say, if, by either improper quantity or quality of the fluxes, insufficient supply of coal, deficiency of either quantity of heat, of the air blast, or through irregular mode of charging, the cinder begins to run sluggish and through such improper mode of operating the furnace any obstructions begin to accumulate in the hearth—in that event the block with the smaller opening is removed and the cinder or obstructions either worked out of the furnace by tools or by the pressure of blast, this being the principal invention of Mr. Luermann, to have a closed-

65 breast and water-cooled opening for discharge of these matters regardless of the size of those openings.

Int. 21. When the block D is removed can the flow of cinder through the large opening be regulated by the regulating flow of the water through the plate C?

Ans. Not with the large opening, and the less it can be controlled the larger the opening.

Int. 22. Are you familiar with the practice of closed-breast blast furnaces in and about Pittsburgh? And, if so, state whether you ever knew them to operate without the block D; and, if so, under what circumstances and how long at a time.

Ans. I repeatedly visited the large blast furnaces, or, in fact, all the blast furnaces in the vicinity, as well as those in the East and West, and during conversation with those in charge thereof heard that they occasionally removed the block D when the furnace's cinder is not running properly, which is then tapped through the larger opening for from six hours to several days, after which they again returned to inserting the cinder block D.

Int. 23. Did you ever see a closed-breast blast furnace working without the cinder block D?

Ans. As far as my present recollection goes, all those furnaces used the cinder block D while I was inspecting them.

Int. 24. Is there any statement in the Luermann patent as to the size of the cinder-discharge opening?

Ans. There is no special size given; and, indeed, it is literally said that he uses large and small openings, the former whenever it is desired to have an opening in the hearth to work through, as when any irregularity in the smelting process has taken place. This he effects by the removal of the piece D.

Int. 25. Does the removal of the block D change the furnace from a closed-breast to an open-breast furnace?

Ans. It does not, because an open-front blast furnace must have tymp, fore hearth, and wall stone, as Mr. Luermann's expressed invention is to dispense with those three elements and pass the cinder through a water-cooled opening, having thus a closed breast, whether discharging through the small or the large opening.

66 Int. 26. What is the result of "irregularity in the smelting process"?

Ans. Whenever the furnace ceases to give fluid cinder, then it more or less adheres to the walls and encloses particles of ore and fuel, which are then protected so much against the action of the blast and insolated from connection with each other as to prevent in the one case combustion and in the other reduction, thus causing their descent into the lower part of the hearth and an accumulation of obstructions therein, which, if not removed timely, may lead to still larger accumulations, scaffolding, and final closing up of the entire furnace.

Int. 27. Do you know what material it is that is referred to as "bone" in the defendant's testimony in this case?

Ans. Under the term of "bone" a mass is understood which frequently is met with in the bituminous and anthracite coal. One

such substance as once analyzed by me, with a view of determining its necessary fluxing, had the following compositions relating to "bone" as it occurred in anthracite: Silica, 55.50; fixed carbon, 24.40; carbonic acid, 0.79; alumina, 15.95; protoxide of iron, 2.11; lime, 1.46; water, 0.18; sulphuric acid, 0.64. If this occurs frequently and is not guarded against in the fluxing, there being such a large additional amount of silica, it is apt to reach the hearth in only a partially fluxed condition and cause the obstruction referred to in the former answer given by me, but if taken account of in the determination of the charge of the furnace the accumulations may be avoided and the fluidity of the cinder preserved. Again, in other places in mining the coal they sometimes take out some of the overhanging part of the coal vein, which in those regions mostly consist of a substance still more refractory than the one just mentioned, having a larger part of alumina. This also can be fluxed, while that substance now and then comes to the furnace, yet the former part is more frequently to be contended with and be provided for, and on account of the advantages to be derived from the use of the Luermann invention, as enumerated in one of my former answers,

67 the furnace, being kept so much hotter, to a very great extent overcomes the bad influence of irregular and improper charging, so that by the very reason of the application of the Luermann patent the frequency of obstructions customary in the open-front furnace is nearly altogether avoided, although instances may occur where parties are compelled, by strikes or other commercial reasons, to change their customary stock and use for a short time such materials with which they are not acquainted and may have no time or be certainly forced to their use without sufficient notice to first examine them, and in such instances Mr. Luermann says they remove the small opening and work through the large opening when irregularities occur. For instance, also in fuel supply, sometimes parties are compelled to use either coke or anthracite of so impure a quality as to contain as low as 65 per cent. of fixed carbon instead of from 80 to 85 or higher ordinarily employed.

Int. 28. Is there any difficulty in removing that bone from the furnace if the cinder block D is removed and the furnace is worked without the cinder block?

Ans. There is not, because even the largest pieces of anthracite—for instance—as employed are diminished so much in size by flying when exposed to the heat that long before they reach the cinder tap they will then pass through such opening, even if they should be coated with cinder during their passage to that point, and assuming even there was no fluxing available for melting any part thereof.

Int. 29. Look at Defendant's "Exhibit Cinder Flush" and state whether the water-cooled plate encircling the cinder opening at the sides and top is a tymp plate.

Ans. It is not a tymp plate, because there is no fore hearth in connection with this furnace.

Int. 30. What is the purpose or what effect does the tunnel-shaped projection beyond that water-cooled plate have on the operation of that plate?

Ans. It only increases unnecessarily the surfaces exposed to wear and repair.

Int. 31. So far as the operation of tapping the cinder is concerned, does it have any effect?

Ans. It is rather more disadvantageous, on account of increas-
68 ing the distance from the hearth to the space where the cinder finally escapes to the outside, and would be better if cut off entirely flush with the outside of the water-cooled plate marked C in Luermann's patent.

Int. 32. Look at the model now shown you and state what it represents.

Ans. The model now in my hand represents a blast furnace with closed breast and water-cooled cinder opening, as referred to in Mr. Luermann's patent.

Int. 33. In what does it differ from Defendant's "Exhibit Cinder Flush"?

Ans. The only difference is that in the Defendant's "Exhibit Cinder Flush" the water-cooled cinder opening has an extension to the outside of the water-cooled plate called C in Mr. Luermann's patent.

(Model referred to by witness offered in evidence as Complainant's "Defendant's Exhibit Cinder Tap.")

Adjourned to 2 p. m.

Met at 2 p. m.

Int. 34. Is it anywhere said in the Luermann patent, to which your attention has been called, that all foreign matters must be reduced to a liquid?

Ans. There is no such interpretation possible from the specification; on the contrary, he distinctly states that at times he might remove solid matters through the water-cooled openings, and for the very reason of anticipating such occurrences occasionally prefers to make the cinder block movable in order to obtain a larger opening through which to work the furnace and remove any solid matter that occurs in it.

Int. 35. In the old open-front furnace was the half-smolten stock which collected in the fore hearth there by intention?

Ans. It was not. The practice of all smelting operations is to produce everything as cheap as possible, and it is only considered as a nuisance to be avoided as much as possible to get such accumulations, but they are more apt to collect in fore-hearth furnaces than in such with closed breast and water-cooled cinder opening, for reasons mentioned before.

69 Int. 36. State whether the fore hearth of such furnaces had to be cleaned out when the furnace was in a good working condition.

Ans. In the best condition of the furnace we generally had to clean it out once at least in twenty-four hours. I only know of one instance in my experience in anthracite furnaces where they got along without cleaning it for about thirty-six hours, and even then

the amount of cleaning occupied about half an hour; but I also know, in other instances, where it occupied each time about from one and a half to three hours, and had to be cleaned from five to six times in twenty-four hours.

Int. 37. Please state what parts of the cinder-discharge opening of a closed-breast furnace require to be water-cooled in order to reserve the limits of the opening.

Ans. More particularly the top, and, after that, the sides; the former part principally because any wear at this point would endanger the structure supported by it, inasmuch as, if worn out, the upper part is apt to fall in, and thus cause long delays and expense for repairs.

Int. 38. Look at the model "Defendant's Exhibit Cinder Flush," in which you will notice there is no water-cooling at the bottom of the cinder opening. Please state whether water-cooling is necessary at that point to preserve the advantages of a closed-breast furnace.

Ans. It is not, because if worn out at that point it is very easily repaired, nothing depending on the part.

Cross-examination by Mr. BALDWIN:

X Int. 39. How far back does your knowledge of blast furnaces in this country extend?

Ans. In this country twenty-one years and in Europe eight years prior to that.

X Int. 40. In your sixth answer you speak of the ordinary furnaces having an adjunct consisting of a box. Of what material was this box composed?

Ans. In some instances it is nothing but natural stone, in others it is a mass rammed in a powdered state, and still in others
70 fire-bricks; and, again, there are such where they are lined in the inside with metal plates on the bottom of the tymp.

X Int. 41. This so-called box in all cases constituted an extension of the wall or body of the furnace with which it communicated by a large opening, did it not?

Ans. By openings of different size, according to the style of the furnace.

X Int. 42. What was the usual width of this opening, say in a thirteen-foot furnace?

Ans. From twenty-four to thirty inches.

X Int. 43. What was its depth?

Ans. That depended on the kind of ore used and the manner in which the furnace was worked. It varied from, say, twenty inches to thirty-six inches.

X Int. 44. How far did this fore hearth project from the furnace?

Ans. From twenty to thirty-six inches, according to the capacity of the furnace, the fuel and the ores in use.

X Int. 45. Was it not the practice to work with much shorter fore hearths than this?

Ans. After Mr. Luermann's invention, a great many tried to come

as near as possible to the advantages derived from Mr. Luermann's invention by shortening more and more the fore hearth.

(Answer objected to as irresponsive and volunteered, and question repeated.)

I understand that they lately shortened the fore hearths considerably.

X Int. 46. How short have you known such fore hearths to be used?

(Objected to as irrelevant, it not being pertinent to any issue in this case.)

Ans. About twelve inches.

X Int. 47. Did these short fore hearths retain the tymp?

Ans. Yes, sir.

X Int. 48. Were those tymps water-cooled prior to 1867?

Ans. In very few cases they were.

71 X Int. 49. In your fifth and sixth answers you speak of the Luermann furnace. Do you mean by that description the furnace described in his patent?

Ans. Yes, sir.

X Int. 50. In your sixth answer you speak of carrying the surrounding walls of the hearth directly, clear down to the bottom stone without any interruption. Did not the hearth of the open furnace extend directly to the bottom stone without any interruption?

Ans. The hearth did, but not the surrounding walls.

X Int. 51. Was it not the practice for many years prior to 1867 to tap melted iron directly from the hearth of the furnace?

Ans. In some places they did tap directly from the furnace, but it was iron.

X Int. 52. In your seventh answer you say, "In consequence of such slacking or stoppage of the blast combustion is interrupted in the interior of the furnace, whereby a larger part of the furnace becomes considerably cooled." Do you mean to say that a stoppage of the blast of the furnace, say for half an hour, would have this effect?

Ans. The effect will always be shown, and the more the longer the blast is stopped.

X Int. 53. In your fourteenth answer you say, in substance, that there are several openings for removing the slag, two of which you describe. Are there any other openings for removing the slag described in that patent?

Ans. There are not.

X Int. 54. I find in that patent these words, "One or more holes are made in the said piece D, through which the slag is discharged." Did you ever know a furnace worked with more than one slag-discharge opening?

Ans. Occasion-ly they remove the slag-discharge block, which has one opening, and by its removal a larger opening is left. This is what I mean by two openings, and the cinder then removed out of that large opening.

X Int. 55. In your sixteenth answer you say, in substance, that both of there openings are water-cooled by circulation of water through piper in the separate boxes contained in the opening.

72 Please point out in the patent where you find that word "boxes" used.

Ans. Not the special term, but the same meaning. It is called here a hollow cinder block and a water-cooled plate.

X Int. 56. Please point out in the patent where the word "cinder block" occurs.

Ans. It does not occur. It is called a slag-discharge piece, the cinder block being the common name by which it is known around the furnaces.

X Int. 57. Please point out where the word "cinder" occurs in the patent, if you can find it.

Ans. In looking over the patent I observe that instead of the word "cinder" the word "slag" is used in the place of the word cinder mentioned by me, but, technically, both have the same meaning, as far as blast-furnace practice is concerned.

X Int. 58. Please point out on the drawings of the patent what you call these water-cooled boxes.

Ans. One of them is marked by letter D, which is the casting containing the small opening—the slag-discharge piece—and the other is the water-cooled plate C, containing the larger opening for cinder to pass through.

X Int. 59. Does the drawing show any method of water cooling the plate C?

Ans. It is not visible on the drawing, but clearly described in the specification.

X Int. 60. Is it shown in the drawing as connected with or independent of the slag-discharge piece?

Ans. It is not shown in the drawing, but so described in the specification. This relates to the water-cooling arrangement.

X Int. 61. Now, please point out in the specification where that connection is described.

Ans. I read as follows: "This plate is also cast or made with channels or pipes running through it, and the channels or pipes of such plate and of the piece D may be so arranged as to connect or communicate with each other when the plate C and piece D are in their proper positions, or they may be independent of each other."

X Int. 62. How would you have gone to work in 1867, with

73 the knowledge conveyed to you by that paragraph, to have connected the water channels of those two pieces?

Ans. By screwing two nipples in the plate C connect them to the pipes of the slag-discharge piece D by means of two unions and a T, the exit from the T to lead to the waste sewer.

X Int. 63. Would that have enabled you to remove the slag-discharge piece?

Ans. It would by unscrewing the unions.

X Int. 64. What would then become of the water circulation in the plate C?

Ans. One end of the pipe union would be connected to the other

half union of the water-supply pipe, and the same proceeding carried out with the waste pipe.

X Int. 65. Under the circumstances you mention wouldn't that have been a pretty hot place to work in?

Ans. Not much, because you have the block inserted in the discharge piece, which is not removed until after the unions between slag-discharge piece D and the plate C are disconnected and connection made between the latter and the main supply and waste pipe. These connections are in front of the plate C.

X Int. 66. In answer sixteen you state, "In either case the limit of the opening is perfectly preserved by such cooling." Is it not a fact that any opening through which the slag is being discharged will wear away or cut out in time?

Ans. The water circulating in the slag-discharge piece cools off the cinder passing through that small hole, which naturally will wear out in time, but not as fast by far as if there was no water-cooling. The same is the case with plate C, containing the large discharge opening.

X Int. 67. In answer seventeen you say, in substance, that in the large opening the water-cooling circulation exists part way of that opening or may be extended inwards. Where do you find that statement in the patent?

Ans. In the following words: "This plate is also cast or made with channels or pipes running through it." I don't find it exactly in those words, but he don't put any words of limitation.

74 X Int. 68. In your twentieth answer your say, "If the furnace is not working properly—that is to say, if by either improper quantity or quality of the fluxes, insufficient supply of coal, deficiency of either quantity of heat, of the air blast, or through irregular mode of charging, the cinder begins to run sluggish, and through such improper mode of operating the furnace any obstructions begin to accumulate in the hearth—in that event the block with the small opening is removed and the cinder or obstructions either worked out of the furnace by tools or by the pressure of blast." Where do you find that in the patent?

Ans. This is embodied in the patent in the words given to explain the object of plate C with the larger opening, which are, "Or if it is desired to have an opening in the hearth to work through, as when any irregularity in the smelting process has taken place."

X Int. 69. Where is it literally said in the Luermann patent, as stated in your twenty-fourth answer, in substance, that he uses large and small discharge openings?

Ans. It is quoted as follows: "The dimensions of the slag-discharge piece are little less than the openings in which it is placed, and the space left around it is filled with sand, which can be readily removed in case it is desired to remove the piece D for repairs or if it is desired to have an opening in the hearth to work through, as when any irregularity in the smelting process has taken place." In further explanation of this it is evident that if, as he says here, while the furnace works regularly it is preferable to use the slag-discharge piece D with the small opening, but if the operation of the

furnace becomes irregular, then it is advised to throw out the slag-discharge piece D for the time being and work the furnace through the large opening in the water-cooled plate C until the operation of the furnace is corrected.

X Int. 70. In your last answer you speak of a small opening, and yet say in your other answer there is no special size given. What do you mean by the term small opening, in view of these statements?

Ans. I mean to say that nowhere in the patent any specific
75 dimensions in inches are given; that the two openings, large and small, are only to be understood as relatively so.

X Int. 71. Have you read defendant's testimony in regard to "Exhibit Cinder Flush"?

Ans. I have.

X Int. 72. Point out in Luermann's patent any water circulation in the dam-plate as exhibited in Complainant's "Exhibit Defendant's Cinder Tap."

Ans. Luermann specifically states that his specific object is to dispense with dam-plate, as well as with tymp and fore hearth, close the hearth entirely, and discharge the cinder through a water-cooled opening. There is no dam-plate in the patent.

X Int. 73. As I understand it from your deposition, particularly your twenty-fourth answer, you have given this deposition with the understanding that Luermann is still within the limits of his invention whether he discharges liquid slag through a small opening and a removable cinder block, cooled by water, or through a larger opening discharges solid matter. Is this correct?

Ans. It is.

IGN. HAHN.

(Here follow diagrams marked pp. 76 & 77.)

79 UNITED STATES PATENT OFFICE.

GEORGE ASMUS, of New York, N. Y., assignee of F. W. Lurmann.

Improvement in Blast Furnaces.

Specification forming part of Letters Patent No. 70447, dated November 5, 1867; reissue No. 3204, dated November 24, 1868.

To all whom it may concern:

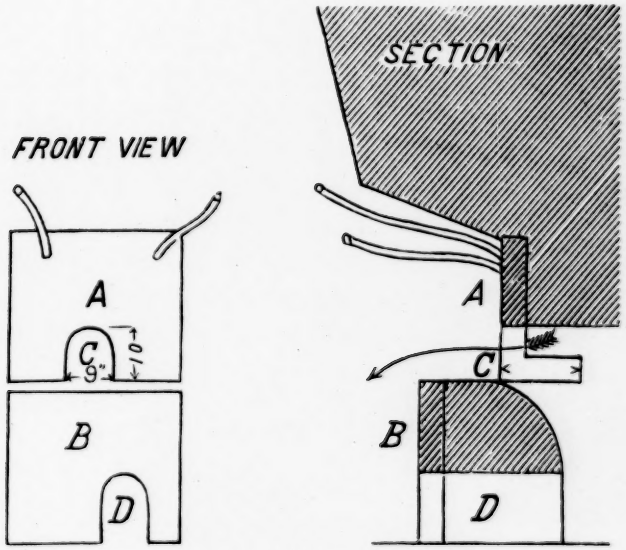
Be it known that F. W. Lurmann, of Osnabruck, in the Kingdom of Prussia, invented a new and useful improvement in blast furnaces, and I, George Asmus, of the city, county, and State of New York, assignee of the said F. W. Lurmann, do hereby declare the following to be a full, clear, and exact description thereof, which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawing, forming part of this specification, in which drawing—

(Here follows diagram marked page 78.)

No. 323.
Freeman
v.
Asmus.
} p. 76.

COMPLAINANT'S EXHIBIT ASMUS.

SKETCH NO. 1.

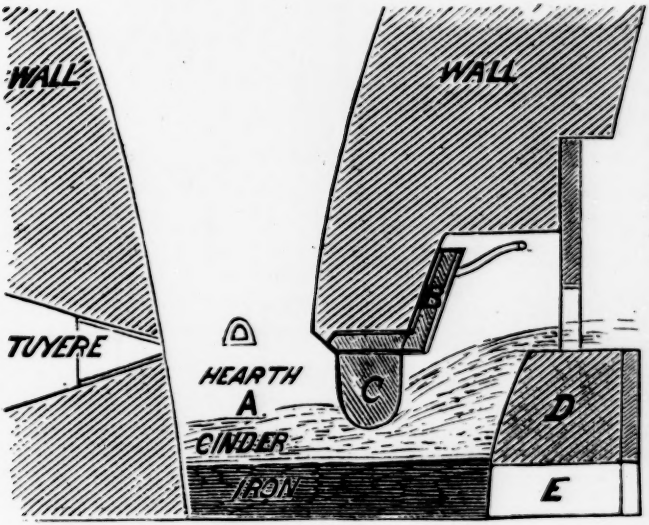


DEFENDANT'S NORTH CORNWALL FURNACE.

No. 323.
Freeman
v.
Asmus
p. 77.

COMPLAINANT'S EXHIBIT ASMUS.

SKETCH NO. 2.



F. W. LURMANN.

Blast Furnace.

No. 3,204. Reissued Nov. 24, 1868.

Fig. 3.

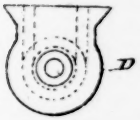


Fig. 4

Fig. 1

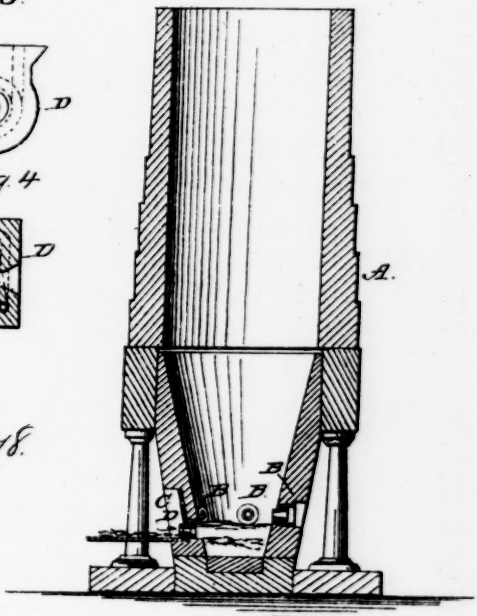
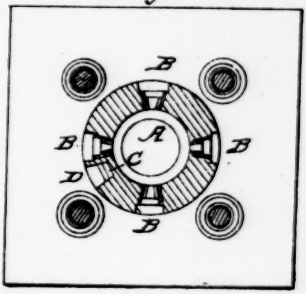


Fig. 2



No. 323.
Freeman
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p. 78.

WITNESSES:
Gustav Borg
Geo. E. Southard

INVENTOR.
F. W. Lurmann
by
Van Santvoord & Lauff

Figure 1 is a vertical central section of a furnace built according to this invention. Fig. 2 is a horizontal section through the tuyeres. Fig. 3 is a front elevation of the slag-discharge piece or cinder block detached. Fig. 4 is a vertical section thereof.

Similar letters indicate corresponding parts.

This invention relates to certain improvements in blast furnaces with a closed breast where the slag is discharged through an opening cooled with water in such a manner that the tymp or fore hearth and the wall stone can be dispensed with, and that the slag can be tapped directly from the hearth. It consists, further, in a slag-discharge piece or "cinder block" of peculiar construction, as will be hereinafter more fully explained, whereby the building of a furnace according to this invention and its correct operation are materially facilitated.

80 In order to enable those skilled in the art to fully understand the object of this invention, I will first point out the disadvantages of blast furnaces with the fore hearth, such as are now in common use for melting iron ore. In such furnaces the slag is driven out by first being forced below the tymp stone, which projects below the level of the tuyeres and intercepts the currents of air and prevents their escape with the slag, which stands in the fore hearth at the same level as on the hearth, the slag being discharged only when it rises in the fore hearth high enough to overflow the top of the wall stone that forms the bottom of the discharging orifice. By this arrangement the tymp stone constitutes a trap, which intercepts the currents of air and causes their pressure to be exerted directly on the surface of the slag on the hearth. This method of construction has several disadvantages, one of which is the difficulty of keeping the tymp stone and the surrounding parts in repair, another is that the pressure of the currents of air or wind is limited by the counter-pressure of the column of slag in the fore hearth, and another is that, one side of the furnace being occupied by the fore hearth, no tuyere can be applied on that side, and consequently the supply of wind is irregularly distributed.

By the improvement which constitutes the subject-matter of this present invention these disadvantages are overcome in a simple and effective manner.

In the drawings the letter A designates the furnace and B several tuyeres, which are arranged therein at a proper height. The furnace is constructed with a closed breast and the sides of the hearth, whether round or square, extend clear down to the bottom stone, the usual opening (not shown in the drawing) being made in the lower part of the hearth for the discharge of the iron. The openings for the tuyeres B are distributed at equal distances apart in the sides of the hearth. At a suitable height from the bottom stone an opening is left in the hearth, in which is placed a cast-iron or brass slag-discharge piece or cinder block, D, which is cast or made with numerous channels or pipes running up and down or in other directions through it, as shown in Figs. 3 and 4. The cinder

81 block D may be formed with a dovetail on its upper end, which is fitted into the bottom of a stationary metallic plate,

C, connected with the furnace, or it may be attached to said plate in any other desirable manner or cast solid with the same, if desired.

The plate C is also cast or made with channels or pipes running through it, and the channels or pipes of said plate and of the cinder block D may be so arranged as to connect or communicate with each other when the plate C and cinder block D are in their proper position, or they may be independent of each other. In the drawing the plate C is shown above the cinder block; but it may also be placed below or in any other desirable position in relation to the same.

The object of the channels or pipes is to permit the plate C and cinder block D to be cooled by forcing water through them while the furnace is in operation, proper connections being made for that purpose with a reservoir of cold water or with a force-pump. One or more holes are made in the cinder block D, through which the slag is discharged, the shape of said holes being shown in Figs. 3 and 4, the middle portion being cylindrical, but each end being conical or flaring. The dimensions of the cinder block are a little less than the opening in which it is placed, and the space left around it is filled with sand, which can be readily removed in case it is desired to remove the block D to repair it or if it is desired to have an opening in the hearth to work through, as when any irregularity in the smelting process has taken place.

The flow of the cooling water through the cinder block D is regulated for the purpose of controlling the discharge of the slag through it. By allowing much cooling water to circulate through its water channels or pipes the temperature of the block D is lowered sufficiently to allow a coating of slag to adhere and choke its discharge openings, which are of less diameter in the middle than at their ends. By reducing the flow of cooling water the cinder block is allowed to retain a higher temperature, and in consequence the slag is melted out of the discharge openings, and they become clear and open and permit the slag to flow without interruption. When the slag in the hearth is below the level of the discharge openings the latter are simply closed by an iron plug.

82 This invention can be easily applied by those skilled in the art to which it belongs to blast furnaces of the common construction by removing the fore hearth and closing the aperture left in the breast of the furnace under the tymp stone by inserting the plate C with the cinder block D.

The principal advantages derived from this invention are as follows: First, it permits a high pressure of wind; second, the hearth is preserved in better condition than where the common mode of construction is retained; third, the labor of the operation of smelting is lessened; fourth, it allows one more side of the hearth for a tuyere; fifth, it avoids the stoppages of the wind supply, now necessary as often as the iron is discharged; sixth, a considerable increase is gained in the product of the furnace, while at the same time the cost of labor and repairs is lessened.

Having thus described this invention what I claim as new and desire to secure by letters patent is—

1. A blast furnace with a closed breast where the slag is discharged through an opening or openings cooled by water, substantially as set forth.

2. The slag-discharge piece or cinder block D, constructed and arranged substantially as described.

3. The cinder block D, in combination with the plate C, to which it is attached, substantially as described.

4. The shape of the discharge opening or openings of the cinder block D, being made flaring at its ends and of diminished diameter in the middle or central part, substantially as described.

5. The combining of the slag-discharge piece or cinder block with a series of water channels or pipes, substantially as and for the purpose above set forth.

6. Combining with the metallic plate C a series of water channels or pipes, substantially as and for the purpose set forth.

7. The method of controlling the discharge of slag from
83 blast furnaces by regulating the temperature of the slag-discharge piece or cinder block, substantially as described.

This specification signed by me this 24th day of October, 1868.

GEORGE ASMUS.

Witnesses:
H. HAUFF.
ERNEST F. KASTENHUBER.

UNITED STATES PATENT OFFICE.

HENRY C. GRITTINGER, of Cornwall, Pennsylvania.

Improvement in Flushing Slag or Cinder from Blast Furnaces.

Specification forming part of Letters Patent No. 209,119, dated October 22, 1878; application filed September 16, 1878.

To all whom it may concern:

Be it known that I, Henry C. Grittinger, of Cornwall, in the county of Lebanon and State of Pennsylvania, have invented a new and useful improvement in the method of flushing slag or cinder from blast furnaces in the manufacture of iron, and certain improvements in apparatus therefor, of which the following is a specification:

The object of my invention is to flush out or remove from the furnace at intervals, with the slag and cinder, any infusible or insoluble material injurious to the iron—such as slate, unburned lime, dirt, &c.

Heretofore in the working of commonly used furnaces of ordinary construction it has been customary, in tapping or removing the melted slag and cinder from a blast furnace, to make an
84 opening under the weight plate, if an open-front furnace, or at a place specifically intended for the purpose, if a closed furnace, usually with an iron bar of small size—say about an inch and a quarter in thickness. Such method is objectionable, the

aperture or flushing opening so made being limited in area by the material surrounding it to a few square inches, thus preventing the carrying off with the slag and cinder of the injurious solid matters or infusible material accumulated in the crucible of the furnace.

Provision has also been made for flushing by a perforated water block or discharge piece in an opening in the hearth of a furnace, through which to discharge the slag, &c. Moreover, it has been proposed to control the discharge (so as to flush at intervals) by regulating the temperature of the discharge piece, so that its opening might choke up by cooling and the clogging slag be melted by heating.

My improvements consist, in the first place, of a novel method, hereinafter described, of flushing or washing out, at intervals, with the slag and cinder, such infusible material or foreign solid substances as may accumulate on the melted iron in the crucible of the furnace, thereby increasing the yield and improving the quality of the iron; and, in the second place, my improvements consist in certain peculiar organization of parts and in certain combinations of devices whereby the furnace is adapted for carrying out my improved method.

I employ an attachment or device provided with a large opening and attached to or inserted either in the side or in the fore part of the furnace a little below the level of the tuyeres, said attachment consisting of a tymp or water breast, which may be either separate from or combined with a water block or tuyere, with or without a bottom, or simply a water block or tuyere, the large aperture or flushing opening being closed by means of a door, which is fastened in position by a ratchet and detent, weighted lever, or prop. The tymp, water block, or tuyere may be made of metal or of fire-clay or any refractory material or a combination of these, and be suitably protected, as may be required, by means of a flow of cold water running through it or through a coil of pipe inclosed in or encircling it in suitable well-known ways. The attachment is placed in position and secured in suitable way, the opening packed and stopped (with wet coal dust and stopping clay), the stopping being prevented from blowing out by securing the door. After the blast has been put on the furnace and continued until the cinder has risen above the bottom of the tuyeres the blast is slackened, the door thrown back, and the outside packing of clay removed and an opening made through the coal-dust stopping. The blast, being again thrown on, speedily removes all the stopping, exposing a large flushing outlet, through which the slag, cinder, &c., is carried off. After nearly all the cinder has been flushed out the blast is thrown off and the aperture again closed preparatory to repetitions of the above-described operation at proper intervals.

The improvements claimed will hereinafter be designated.

In the accompanying drawings—

(Here follow diagrams marked pp. 88, 89, & 90.)

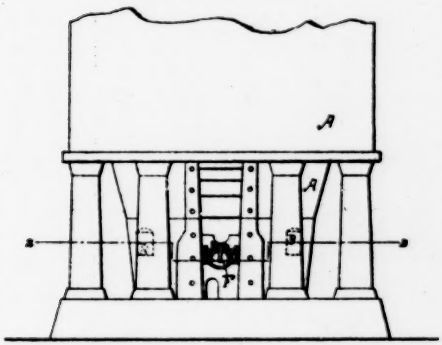
2 Sheets—Sheet 1.

H. C. GRITTINGER.

Flushing Slag or Cinder from Blast-Furnaces.

No. 209,119. Patented Oct. 22, 1878.

Fig 1.



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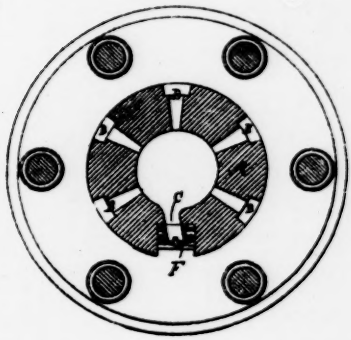
Freeman } p. 88.
v.
Asmus.

Fig 2.



WITNESSES

Geo W Breck
Wm G Kilgore

INVENTOR.

Henry C. Grittinger.

By his Attorneys
Baldwin, Hopkins & Peyton.

89

2 Sheets—Sheet 2

H. C. GRITTINGER.

Flushing Slag or Cinder from Blast-Furnaces.

No. 209,119. Patented Oct. 22, 1878.

Fig 3.

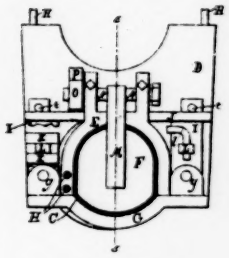


Fig 5.

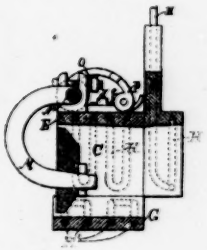


Fig 4.

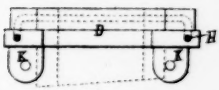
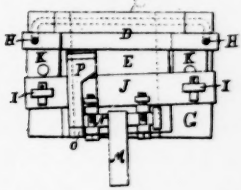


Fig 6.

Fig 7.



No. 323
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p. 89

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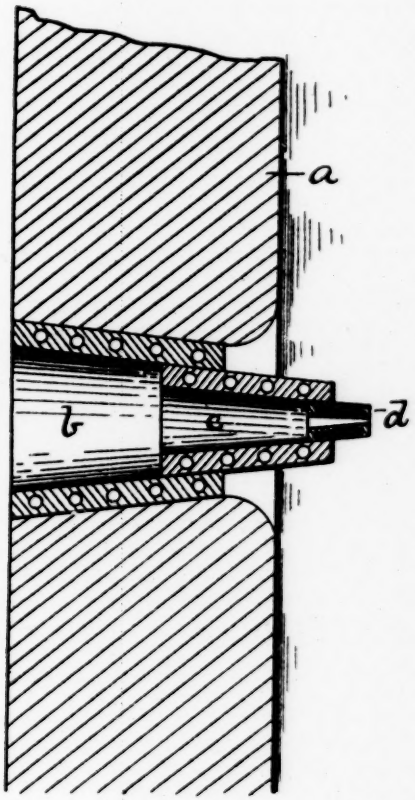
} p. 90.



COMPLAINANT'S EXHIBIT KENNEDY.

W.P.C. Ex.

Asmus vs Freeman and Alden Sept 16-85

U.S.Circuit Court

Eastern District of Pa.

which show so much of a blast furnace as is necessary to illustrate my improvements or means for carrying out my method, embodied in the best way now known to me, figure 1 is a front elevation of the furnace with the shaft omitted, that portion downward from or including and below the boshes only being shown; Fig. 2, a cross-section on the line 2 2 of Fig. 1. Fig. 3 is a view showing in detail the front of the flushing device or attachment, with parts removed; Fig. 4, a top view of the tymp or water breast; Fig. 5, a section on the line 5 5 of Fig. 3; Fig. 6, a top view of the weight plate, to which the water block is attached; Fig. 7, a top view of devices shown in Figs. 3 and 5.

Any suitable furnace, A, is provided with tuyeres B of the desired number, and a little below the level of the bottom portions of the tuyeres is provided a flushing opening, C. The top of the opening C might be on a level with the bottoms of the tuyere openings, or very slightly above, but it is preferably below the level of the tuyeres.

The device or attachment (considered as a whole) by which the flushing aperture is provided and secured to the furnace is, in the present instance, constructed as follows—that is, made up of a tymp or water breast, D; a water block or tuyere, E, with the large opening C; a hinged door, F, to close the opening, connections, or coupling attachments (presently to be described) between the different parts; a weight plate or bottom, G, for the water block, and water-circulating pipes H and H′ for cooling the parts.

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The tymp D may be cast in one piece with the water block E and weight plate or bottom piece G or the weight plate with the tymp be cast separately from the water block, as shown by the dotted lines, Fig. 4. In the preferred construction (shown by the drawings) the weight plate G is secured to the bottom of the water block by means of lugs *g g*, on the weight plate, to which are jointed bars or upright rods I I, which are shouldered near the upper ends and pass through openings in the ends of a cross-bar, J, on the top of the water block, and are secured to said cross-bar by keys or wedge-pins *e e*, passing through the uprights I above the bar. Lugs K K, on the tymp plate or water breast D, serve, in connection with eye-bars or short links L L and the rods I I, to connect the water block and tymp plate. The links are each pivoted at one end to the lugs K and at their opposite ends are shouldered and pass through openings in the rods I and are drawn tight and secured by pins or wedges *l*, passing through the links in front of the rods. By this construction any part of the device which may be broken or otherwise injured may be removed and renewed without impairing the rest.

The door F is secured to a curved hinged arm or bail, M, attached to a pivot or turning rod, N, removably mounted in suitable bearing lugs or supports upon the top of the water block. A suitable notched disk or ratchet stop, O, upon one end of the rod N, is acted upon by a detent, P, so as to securely hold the door when closed, but any other suitable securing device may be employed.

The operation is as follows: Before putting the blast on the furnace the aperture or opening is closed first with wet coal dust prop-

erly packed with a stopping hook to within a few inches of the outside. Upon this is then packed in a similar manner a few inches in thickness of stopping clay, and all securely prevented from blowing out by the door properly fastened. After the blast is put on the furnace I prefer to let the cinder in the furnace rise above the bottom of the tuyeres. The blast is then slackened upon the
87 furnace, the door unfastened and thrown back, and the outside packing of clay removed. An opening is then made through the coal-dust stopping by means of an iron pricking bar. The blast is then thrown on the furnace again and speedily removes all the coal-dust stopping with the washing out or flushing of the slag or cinder, which also carries off with it such infusible material as may have passed down to the crucible of the furnace. After nearly all the cinder has been flushed out the blast is thrown off the furnace and the aperture again closed in the manner above described.

The above-described operation is repeated at intervals between the successive times for casting or running the iron.

By my improvements in the manufacture of iron the yield of the furnace is increased and the quality of the iron materially improved.

I claim as of my own invention—

1. As an improvement in the manufacture of iron, the hereinbefore-described method of flushing the cinder, &c., directly from the furnace at intervals, which consists in slackening the blast and opening the flushing aperture, then throwing on the blast to flush and again slackening to admit of the closing of the flushing aperture, substantially as set forth.

2. A blast furnace provided with the tuyeres, the flushing aperture, and the door for closing said aperture, substantially as and for the purpose set forth.

3. The hereinbefore-described sectional flushing device or attachment, consisting of the combination of the tymp or water breast, the water block or tuyere, provided with the large opening, the hinged door, the weight plate, and the water-circulating pipes.

In testimony whereof I have hereunto subscribed my name.

HENRY C. GRITTINGER.

Witnesses:
GEORGE WALTZ.
WM. C. FREEMAN.

91 In the United States Circuit Court, Eastern District of Pennsylvania.

GEORGE ASMUS
vs.
MARGARET C. FREEMAN. } In Equity. No. 8. April Session, 1884.

Defendant's Record.

Wm. D. Baldwin, Wayne MacVeagh, defendant's counsel.

92 Circuit Court of the United States, Eastern Division of Pennsylvania.

GEORGE ASMUS
vs.
MARGARET C. FREEMAN. } No. 8.
April Session, 1884.

Examination of witnesses and other evidence on behalf of defendant under the 67th rule in equity, as amended, pursuant to the annexed agreement of counsel and notice hereto attached, before Howard C. Shirk, special examiner, at his office, corner 9th and Willow streets, Lebanon, Pa., beginning February 11th, 1885, at 10 o'clock a. m.

Present: Thomas S. Kerr, Esq., on part of complainant, and Wm. D. Baldwin, Esq., on part of respondent.

Counsel for respondent offers in evidence the following exhibits, respectively marked as hereinafter mentioned, to wit:

Certified copies of the following documents:

1. Assignment from F. W. Lurmann to George Asmus dated July 12, 1867, recorded September 16, 1867, marked "Exhibit Assignment."

2. Letters patent 70477, granted F. W. Lurmann for improvement in blast furnaces November 5, 1867, marked "Exhibit Lurmann Patent."

3. File contents and drawing of the application for the reissue of the aforesaid letters patent No. 70477, reissued to George
93 Asmus, assignee of said Lurmann, November 24, 1868, marked "Exhibit Reissue File."*

4. Docket entries and extracts from the record of the suit of George Asmus *vs.* Dunbar Furnace Company *et al.*, No. 215, November term, 1877, in the circuit court of the United States for the western district of Pennsylvania, marked "Exhibit Dunbar Suit."

The following are the parts offered in evidence under this heading:

1st. Docket entry.
2d. The bill.
3d. The subpœna and endorsements thereon.
4th. The answer.
5th. The replication.
6th. The motion to close testimony and order thereon.
7th. Notice of complainant's testimony.
8th. Extracts from the record, being the parts relating to the testimony of George Asmus comprised in the following pages of the certified copy of the Dunbar suit, to wit: Page 22; the paragraph lines 24 to 32, both inclusive; page 33, and lines 20 to 26, both inclusive, page 49 thereof.
9th. Order for decree and endorsements thereon.
10th. Decree and endorsements thereon.

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* For reissue specification see "Exhibit Complainant's Patent," complainant's record.

11th. Clerk's certificate.

5. Drawing and translation of Merle's French letters patent 20368, for improvements in blast furnaces, granted July 27, 1854, marked "Exhibit Merle Patent."

6. United States letters patent No. 1057, granted Isaac C. Bryant December 31, 1838, for improvements in the furnace for manufacturing iron, marked "Exhibit Bryant Patent."

94 7. United States letters patent No. 38513, granted to Stileman and Ellis for improvements in melting and smelting furnace May 12, 1863, marked "Exhibit Stileman & Ellis Patent."

8. Translation from the text, page 158, vol. I, of Kerl's Metallurgy, and tracing of figure 33, sheet 2, in the matter of the same, "Saxon Fire Smelting Furnace," published at Freiburg, 1855, marked "Exhibit Kerl."

9. Description of hearth for blast furnaces and tracing of figures 32, 44, 47, 49, and lower portion of figure 29, in the matter of the same, from Percy's Metallurgy, Iron and Steel, London, 1864, marked "Exhibit Percy."

(It is stipulated between counsel that typewriter copies of the text of the above-mentioned exhibits, certified by the examiner, may be substituted for the originals, which are to be produced when called for.)

Defendant also offers in evidence the following models:

10. A model illustrating the construction of the lower portion of the defendant's furnace at North Cornwall, marked "Exhibit Furnace."

11. A model of the open front of said furnace as originally used, marked "Exhibit Open Front."

12. A model of the same with Grittinger's cinder-flushing attachment, marked "Exhibit Grittinger."

13. A sectional model of an old open-hearth furnace, marked "Exhibit Open Hearth."

14. A sectional model illustrating the construction of the flushing arrangement of defendant's furnace, marked "Exhibit Cinder Flush."

15. A similar illustrative model of Lurmann's slag-discharge apparatus, marked "Exhibit Lurmann."

Henry C. Grittinger.

HENRY C. GRITTINGER, a witness produced on the part of the respondent, being duly sworn, deposes and says:

Q. 1. State your name, age, residence, and occupation.

95 A. My name is Henry C. Grittinger; aged forty-two years; residence, Cornwall, Pa.; occupation, blast furnace manager.

Q. 2. What is your present occupation—that is, by whom are you at present employed?

A. I am employed by Margaret C. Freeman and R. W. Coleman's heirs. I have charge of North Cornwall furnace and the two Bird Coleman furnaces, all located at Cornwall, Pa.

Q. 3. How long have you been so engaged?

A. Since 1871 at North Cornwall and since 1882 at Bird Coleman.

Q. 4. Describe the construction of the cinder-flushing devices used in these three furnaces.

A. I can best do this by reference to certain sketches made by me and which I now produce.

(Sketches offered in evidence respectively marked Exhibits Grittinger 1, 2, 3, and 4.)

The one marked No. 1 shows the first method, used from 1875 to 1878. This was the first year the furnace started—that is, the North Cornwall furnace. The No. 1 Bird Coleman furnace was started in the spring of 1876 and the other, No. 2 Bird Coleman, in 1880.

The sketch No. 1 shows an open fore hearth with a removable weight plate and prop. It has a water-cooled dam, side cheeks, and tymp. In working a furnace with this fore hearth the weight plate was raised from six to eight inches above the level of top of dam, as shown in the sketch. The slag or cinder was tapped through an opening between two pigs placed between the top of dam and the weight plate. The moulten iron was tapped out through an opening in dam and dam-stone, as shown in sketch. It was customary to remove the weight plate and prop every morning after tapping out the iron for the purpose of taking up or breaking the crust that formed under the weight plate; a clay stopper was then packed under the tymp; the object of the stopper—which seldom
96 exceeded six inches in depth below the tymp—was to reduce the level of the moulten slag in the main hearth, and at the same time protect the tymp from being cut away by the moulten slag and blast coming in contact with it. The weight plate was then put in place again on a level with top of dam, the pigs having been taken away.

After the blast having been on the furnace for several hours the weight plate was again removed, the pigs replaced on the top of dam, and the moulten cinder was forced up to a level with top of pig by a pressure of blast in the furnace. Clay and coal dirt were forced down between side cheeks and moulten slag to make it more easily removed, and the weight plate and prop were again — hour longer the slag was tapped through a small aperture put into position.

After blowing the furnace about an hour longer the slag was tapped between the pigs, the aperture being usually about one inch in diameter. The weight plate was about two feet and a half square, being the distance between the tymp and the dam and the side cheeks on either side. The cinder was allowed to run through the opening between the pigs until the blast blew through. The opening was then stopped up with clay. After running on a short time longer the weight plate and prop were again removed for the purpose of working the furnace.

The working of the furnace consisted in the removal of the effete or dead matter that accumulated in the fore hearth by forcing the same upward with a light-blast pressure and then shovelling it off.

It was also necessary at times to loosen the material by means of wringers and crust bars, which were inserted in the fore hearth. It frequently happened that the slag and effete material in the fore hearth became chilled up and could be removed only with difficulty.

In such cases we were compelled to abandon the working of the furnace in the manner above described and remove the slag through the opening marked "cinder notch" on sketch No. 2 until the
97 fore hearth, by the operation of the furnace, became hot enough to undermine the crust and melt the effete matter and make the crust removable. We frequently ran for weeks with the fore hearth in this chilled condition. We found that we were able to control with difficulty the sides of the cinder notch, owing to the blast and slag enlarging it to too great a size. We thereupon introduced a regular tuyere to tap the cinder through, but found that it did not answer the purpose, because the coils were cut in a very short time. We then tried a large cast-iron pipe lined with clay with better success, but experienced difficulty in keeping the slag from chilling up at the lower end. We then tried a cast-iron block lined with fire-brick with indifferent success.

We then had a new tymp made with semicircular opening, as shown in sketches Nos. 3 and 4, No. 3 being in vertical longitudinal section and No. 4 being a front view; also attached to same a cast-iron cinder block lined with fire-brick, as shown in said sketches. We also placed a cast-iron weight plate under the cinder block for the purpose of keeping it in place.

The first bottom piece on plate and cinder block had coils of pipe through them for the purpose of protecting the material of which they were constructed, but after several trials the water-cooling pipe in same were abandoned, as the sudden expansion that was caused by the flow or slag through the same and the chilling after effect of the circulating water caused the same to crack in a very short time and render them useless.

We, however, continued using circulating pipe in both the tymp and the dam, which are the only water-cooled appliances we are using in connection with our cinder-flushing arrangement, and this is done merely to protect the materials of which they are composed.

This description applies more particularly to the North Cornwall furnace, owned by Margaret C. Freeman, but was used as No. 1 Bird Coleman, furnace until 1882. This furnace was then rebuilt, and a modified form of tymp, side cheeks, and cinder notch were used.

98 No. 2 Bird Coleman furnace, built in 1880, has the same modified arrangements.

Q. 5. I now show you the model "Exhibit Cinder Flush." What does it represent?

A. This represents a vertical sectional view of the arrangement in use at North Cornwall furnace. The No. 1 Bird Coleman furnace, prior to its being rebuilt, three years ago, was, so far as the cinder-flushing arrangement is concerned, like this model. When it was rebuilt it was like the model, except there was no dam under cinder notch

and the side cheeks were smaller. The No. 2 Bird Coleman furnace was the same.

Q. 6. Did you or not ever use practically during the running of the furnaces referred to in the last question water to cool anything other than the tymp and the dam?

A. Nothing connected with the cinder-flushing arrangement.

Q. 7. Please describe the operation of the furnaces we have referred to, so far as the flushing of cinder is concerned?

A. In the use of cinder notches of my construction I have returned to the general idea of the old open-hearth furnace, in that I do not dissolve the effete matter and pass it out as a liquid with the slag, but I discharge the effete or dead matter in the solid form, blowing it out in the solid form with the slag. Thus, when I wish to flush cinder from any of the furnaces, I first slack the blast, then open the door closing the cinder block, remove the clay stopping and part of the coal dust that has been packed under the tymp; the blast is then put onto the furnace and a hole pricked through the remaining coal dirt, which soon enlarges to the full size of the opening of the cinder block and allows full egress for the slag and solid material that is washed out with it. After the cinder has been all flushed out the blast is thrown off the furnace and the tapping hole or cinder notch is closed up with coal dirt rammed under the tymp
99 and an outside stopper of clay is rammed in and the door closed and fastened on same. The blast is then put on the furnace and the smelting operation then resumed.

Q. 8. Please state the size in cross-section of the cinder openings that you are using.

A. The opening in casting is fourteen by fourteen inches. This we reduce generally to an opening ten by ten inches by a clay packing or lining. In certain conditions of the furnace we reduce the opening to an area of about fifty square inches. This is done by packing in clay. When the slag is very hot and fluid we reduce the size of opening to the smallest size above named, and where it is thick and sluggish we open to full size cinder notch, fourteen by fourteen inches, by taking out all clay.

Q. 9. You speak of reducing the area of the cinder notch. Have you or not ever been able to effect such reduction by circulating water in tymp and dam, and thus causing the slag to adhere to the inside of the cinder notch?

A. We never could, but experienced in first using water coils in our cinder block that instead of the water protecting the cast iron of which the cinder block was made and causing the slag to adhere to same the iron was soon cut away and the coils were cut and began leaking.

Q. 10. How long did such experimental use of the water in the cinder block continue?

A. Only a few weeks, as we found the renewal of the blocks cooled with water to be too expensive.

Q. 11. Then the furnaces were never run practically with water at any other parts of the cinder-flushing arrangement than is shown in white on "Exhibit Cinder Flush"?

A. No, sir; they were not.

Q. 12. Have you ever formed the portion of the tunnel or cinder block in front of the tymp of any material other than cast iron?

A. We have frequently formed it of fire-brick, using
100 two sixteen-inch blocks on each side of the opening and covering the same with block. Such devices have lasted six months fully, and we are now using such a structure at No. 1 Bird Coleman furnace.

Q. 13. The complainant, in his 23d answer, states that you showed him the furnace at North Cornwall May 17th, 1883, and put in Asmus sketch No. 1 as a representation of the cinder-flushing arrangement of that furnace at that time. Examine that sketch now shown you and state whether it correctly represents the construction of that furnace at that time.

A. It does not represent the construction at that time.

Q. 14. State in what particulars it is incorrect.

A. He has the projection of the base of tymp into the furnace as being twelve inches long, whereas it is but six, and he does not show the cinder block attached to outside of tymp, nor the bottom plate under the cinder block, nor the method of closing the opening in said cinder block by means of a door attached to a curved bail. "Exhibit Grittinger" is a correct representation of the arrangement there and now used.

Q. 15. The complainant in the suit of Asmus *vs.* Alden also testified in relation to the Bird Coleman furnaces and produced a sketch of them, likewise marked "Asmus sketch No. 1," which I now show you. State whether that is a correct representation of the construction of those furnaces at that time; and, if not, in what respect it is incorrect.

A. It is not correct, the dam and iron notch being located at the fore part of furnace and the cinder-flushing device to one side. The cinder-flushing device is composed of a water-cooled tymp and side sheets, and the cinder block is made with fire-brick, as hereinbefore described by me.

Q. 16. In his third answer Mr. Asmus states that in the Bird Coleman furnaces "the opening in plate C is filled with loam
101 or clay, and the small hole is punched through the filling whenever the cinder is to be tapped." Is that a correct description of the operation of that device?

A. It is not. I have described the correct operation before.

(Defendant's counsel offers in evidence British letters patent No. 1000, granted to Daniel Dalton, for furnaces, dated May 4, 1855, sealed November 3, 1855, marked "Exhibit Dalton.")

(Also British patent No. 1470, granted to George Bedson, for cupolas and blast furnaces, dated June 12, 1863, sealed December 4, 1863, marked "Exhibit Bedson.")

LEBANON, PA., *February* 12, 1885.

Met at 10 a. m., pursuant to adjournment.
Present: Same counsel as before.

HENRY C. GRITTENGER was cross-examined as follows:

X Q. 17. In your 4th answer you say, "We then tried a cast-iron pipe lined with clay." Was that pipe water-cooled?

A. No.

X Q. 18. In the same answer you say, "We then tried a cast-iron block lined with fire-brick." Was that block water-cooled?

A. It was not.

X Q. 19. What is the size of the solid matters which come out with the slag in your furnaces?

A. It varies from one cubic inch up to fifty cubic inches and varied from one to five inches in diameter.

X Q. 20. What was the modified arrangement that you have mentioned at the end of answer four?

A. It consisted in moving the cinder notch around to one side clear on the dam, which latter remains at the fore part of the furnace as heretofore. The cinder notch is composed of a water-cooled tymp and side cheeks and a cinder passage formed by a block or
102 tunnel extending out from the tymp. The tunnel in front of the tymp is made of an ordinary casting, separate from the tymp and removable; it is not water-cooled, and frequently when it was burned out fire-bricks at the side and top were substituted for it.

X Q. 21. In your answer No. 7, describing the operation of flushing cinder at defendant's furnaces, you say: "When I wished to flush cinder from any of the furnaces I first slack the blast." Please state how long the blast remained slackened for that stop of the flushing operation.

A. It was only for a long enough time to remove the clay stopper and put a splasher plate in front of the cinder notch to prevent the slag from flying over the casting-house. The slackening of the blast is not necessary for the flushing operation, but it is essential for the safety of the men. We use 9 to 10 pounds of blast pressure, and have sometimes over a 10-inch opening. The blast is slackened for one-half to a minute; the whole flushing operation takes about 2 or 3 minutes, whereas with a small opening it would take fully 15 minutes. The two to three minutes includes the whole operation up to the closing of the door and putting on the blast. If the furnace is working cold it will take longer. I have known it to take five minutes, but this is exceptional.

X Q. 22. How often do you flush cinder in 24 hours?

A. Nine times. We cast every eight hours and flush three times between each casting operation.

X Q. 23. You tap your metal directly from the crucible of the furnace through the wall, do you not?

A. Yes, sir.

X Q. 24. In the old or open-front form of furnace, the operation

of which you have described, the stopper extending down from the tymp acted as a trap between the hearth and fore hearth, did it not?

A. No, sir; the tymp was above the level of the dam and it could not act as a trap.

103 X Q. 25. I mean did it not prevent the blast from passing out through the fore hearth when the weight plate was removed until the cinder fell below the lower end of the stopper?

A. It did; but the object of the clay stopper in our practice was not to form a trap but to protect the tymp and to reduce the level of the slag.

Redirect:

Q. 26. Please look at "Defendant's Exhibit Model Open Hearth" and state if water-cooled tymps, such as are there shown, were or not known and used before the year 1865.

A. They were.

HENRY C. GRITTINGER.

David Campbell.

DAVID CAMPBELL, a witness produced on the part of the respondent, being duly sworn, deposes and says:

Q. 1. State your name, age, residence, and oocupation.

A. My name is David Campbell. I am fifty-two years of age; my residence is Reading, Pa. I am the superintendent of Henry Clay furnace.

Q. 2. How much experience have you had in running blast furnaces?

A. I have been at furnacing since 1858.

Q. 3. Please look at Grittinger Sketch No. 1 and state whether or not that is a fair representation of what is commonly known as an open-front furnace.

A. Yes, sir.

Q. 4. Please look at section model now shown you, "Exhibit Open Hearth," and state whether it is or is not a fair representation of an old furnace having an open hearth.

A. It is.

Q. 5. For how long have you been acquainted with such style of furnaces?

104 A. I have been acquainted with such furnaces since 1858.

Q. 6. Please state the dimensions, if you can, of the hole through which the cinder was tapped in such furnaces.

A. It would vary, and you cannot confine yourself to one size. We would start with an inch hole and it would get to be a five-inch hole.

Q. 7. Please state whether the weight plate was in the position shown by the drawing and model when cinder was tapped.

A. Yes, sir; the plate would be the same.

Q. 8. When the weight plate was removed to work the furnace,

was it or not the fact that it was customary to draw the cinder before the removal of the weight plate?

A. We always tapped the cinder first and removed the weight plate afterwards.

Q. 9. Have you ever seen before 1865 a furnace with what is commonly known as a chilled fore hearth?

A. Yes, sir; I have seen many.

Q. 10. Please give an example.

A. At Middletown, at James Wood & Co.'s furnace, we had the fore hearth chilled as much as it was opened.

Q. 11. Please look at Grittinger Sketch No. 2 and state whether or not that is a fair representation of a furnace with a chilled fore hearth such as you have referred to.

A. Yes.

Q. 12. When a furnace was in this condition, with its fore hearth chilled, how was the cinder removed? Please state, if you know.

A. We usually drilled through until we got into the furnace, either at the front or some other point.

Q. 13. How big a hole did you usually thus drill?

A. We would usually start with a two-inch drill. If the chilled material was too hard we would finish the work with a smaller drill.

Q. 14. During the period that the fore hearth of the furnace was chilled could you or not remove any foreign material through the fore hearth?

105 A. We could remove anything that could come out through the small slag hole.

Q. 15. State, if you know, what happened or what became of the foreign material that could not be removed through the slag hole.

A. It was melted and consumed in the furnace. The foreign material would melt and come out with the slag.

Q. 16. Then, as I understand you, if the fore hearth was chilled and the foreign material was being consumed in the furnace you would continue the operation of the furnace under these conditions until the fore hearth was again open. Am I right?

A. Yes, sir; unless some other thing happened to the furnace to stop it.

Q. 17. Do I understand that you are referring to your experience before 1865 or after?

A. This was before 1865. This was the old way.

Q. 18. You are still operating furnaces, I think?

A. Yes, sir.

Q. 19. What furnaces?

A. The Henry Clay furnaces, Reading, Pa.

Q. 20. How are these furnaces constructed?

A. They have the old open front—about the same as the model "Exhibit Open Hearth."

Q. 21. Are the fore hearths chilled or not in such furnaces?

A. I have one chilled and one open. I don't bother much about it.

Q. 22. Do you or not operate these furnaces for long periods with the fore hearths chilled?

A. Yes, sir; I do.

Q. 23. Please state for what period of time you have operated them with fore hearths chilled.

A. I have had them chilled for six weeks to two months.

Q. 24. What difference, if any, is there in your products when working in these two ways?

A. I find no difference in the products. In my experience, there is no difference in either way.

106 Q. 25. Can you state whether any other expedients than drilling through the fore hearth were resorted to before 1865 for getting rid of the slag in a furnace the breast of which was closed?

A. We tapped cinder through, beneath, and between the tuyeres. This — before 1865.

Q. 26. Can you state where you so tapped cinder through the tuyeres?

A. At James Wood & Co.'s, Middletown.

Q. 27. How often did you do that?

A. Frequently.

Q. 28. Were these tuyeres water-cooled or not?

A. Yes; at the time we used the shell tuyeres.

Q. 29. How long would you thus discharge cinder through a tuyere?

A. Every hour, say, for twenty-four hours at a time. Sometimes as long as a week.

Q. 30. What was the practice before 1865 as to water-cooling the various parts of the furnace?

A. We cooled the front or dam, the tymp, and sides with water running through.

Q. 31. How was the flow of cooling water controlled?

A. By stop-cocks on pipes.

Q. 32. What was the object of cooling the parts?

A. To preserve the tymp, dam, and sides.

(Counsel for the complainant objects to so much of the foregoing testimony as relates to the tapping of cinder through tuyeres at the furnace of James Wood & Co., at Middletown, as inadmissible under the answer, no notice of the same having been contained therein.)

(Also to "Defendant's Model Exhibit Open Hearth," as not a correct representation of an open-front furnace as constructed prior to 1867.)

Cross-examination (reserving objections):

X Q. 33. Where did you ever know of a furnace constructed
107 like "Defendant's Exhibit Open Front?" I refer particularly to the position of the tymp, stopper, and dam-plate, the length of the stopper, and the relative heights of the top of the dam-plate and the lower end of the tymp.

A. I have known furnaces having the lower end of the tymp from four to six inches above the top of the dam. I have known

them as high as ten inches. It was of very little account as long as we kept it high enough. The stopping would be put in about level with the dam. Sometimes it would wear off and at others it would gather. When it wore off we would have to renew it.

X Q. 34. What is the horizontal piece, painted red, which stand-between the weight plate and the dam in the "Model Exhibit Open Hearth" designed to represent?

A. It represents clay.

X Q. 35. In tapping cinder in those furnaces with which you had experience, did you have to raise the cinder?

A. If we tapped above the cinder the blast would raise it out.

X Q. 36. Please describe how you tapped the cinder in the open-front furnaces like "Exhibit Open Hearth" with which you had experience prior to 1867.

A. We cut a hole with a chisel bar through the clay that was between the weight plate and the dam as horizontally as we could. Sometimes it would be inclined a little.

X Q. 37. Was it inclined enough to go below the tapper on the lower end of the tymp?

A. It would have to come below the stopper.

X Q. 38. Where did you tap cinder in that way prior to 1867?

A. At James Woods & Co., at Middletown.

X Q. 39. Was the metal tap in that furnace through the dam-plate and fore hearth?

A. Yes, sir.

X Q. 40. Did you ever have any difficulty in tapping metal on account of the chilling of the fore hearth?

A. Yes, sir.

108 X Q. 41. What did you do then?

A. We resorted to the different ways of getting the iron out. We used steel bars and drills to drill through the chilled stuff on the fore hearth. We also used sulphur and salt and lead to soften things.

X Q. 42. How long did it usually take to get the iron out under these circumstances?

A. It would vary from fifteen minutes to half a day.

X Q. 43. What was the furnace doing in the meantime?

A. The furnace would be working regularly along. The blast would be on.

X Q. 44. How often did the fore hearth chill up?

A. It would be a matter of frequent occurrence; put it about half the time.

X Q. 45. How long did it take to clean it out, and how often did you do it?

A. We would work from an hour to an hour and a half. If this did not open it we would leave it alone and let it open itself; this would take twenty-four hours or more.

X Q. 46. Did you, during any of these operations, slacken or shut off the blasts?

A. Very frequently we would stop; we would slack the blast usually.

X Q. 47. About how long a time in twenty-four hours would the blast be slackened?

A. Three to five times in twenty-four hours; each time from thirty minutes to an hour.

X Q. 48. About how long a time in twenty-four hours would the blast be stopped?

A. It might possibly be in twenty-four hours one hour; not more.

DAVID CAMPBELL.

Edgar S. Cooke.

EDGAR S. COOKE, a witness produced on part of the respondent, being duly sworn, deposes and says:

109 Q. 1. State your name, age, place of residence, and occupation.

A. My name is Edgar S. Cooke; I am thirty-three years old; I reside at Pottstown, Pa.; I am manager of the Warwick Iron Company.

Q. 2. What experience, if any, have you had in blast-furnace practice?

A. I have been acquainted with blast furnaces since 1868 and I have been a manager since 1873.

Q. 3. Are you accustomed to open-hearth furnaces?

A. Yes, sir.

Q. 4. Will you please state, if you know, how such furnaces are operated as regards the slag discharge and the discharge of foreign matter through the fore hearth?

A. We discharge the cinder by drilling a hole through the clay underneath the crust or weight plate at an inclination reaching to the stopper under the tymp. The cinder was discharged by a pressure of blast through the opening thus made. As drilled, the hole would be from an inch to two inches in diameter, but by the corrosive action of the flowing slag and the blast this hole would soon be enlarged to four to five inches in diameter, oftentimes thus permitting the liquid slag to carry out mechanically any impure material, such as slate and bone of coal, that might lie in the crucible of furnace. When the cinder was removed to the level of the bottom of the stopper the blast was slackened and the hole or passage was well stopped with clay and driven back towards the tymp as far as possible, when the blast was put on again and the operation of smelting went on as usual.

Q. 5. Are you acquainted with furnaces now in operation using what is known as the Lurmann or Asmus invention?

A. Yes, sir.

Q. 6. Do you know how in such furnaces the bone and slate are disposed of?

110 A. They are fused and form part of the liquid slag and pass out as liquid slag. Unless the slagging piece is removed they must be passed out as liquid. If the slagging piece is removed at the cost of time and labor the refuse matter can be removed mechanically through the larger opening thus made.

Q. 7. Had you had sufficient experience in blast furnaces, their running and management, to state as to the relative advantages resulting from the different methods of operation in use?

A. Yes.

Q. 8. I understand from your testimony that there are two known and practiced methods of operating blast furnaces—one consists in discharging mechanically with the slag through a large hole the bone and slate and other unfused materials, while the other method consists in discharging the slag through a small orifice and allowing the bone and slate to remain in the furnace until fused with the slag and then discharging the slag and such fused material as a liquid. What I want to know is which of these two methods do you consider the best, the most practical, and the most economical?

A. This would depend entirely on circumstances, as to the character and quality of fuel used, and also to the quality of the ores smelted. With anthracite coal as a fuel and with the average quality as received at the Schuylkill Valley furnaces, I would prefer the former method, especially so if sulphurous ores are also used. With coke of fair quality and ores comparatively free of sulphur, I would prefer the latter method. With anthracite coal there is usually a considerable portion of slate and bone. A portion of this reaches the hearth or crucible of furnaces, passes below the tuyeres, and not only obstructs the hearth, produces no heat, but rather absorbs it. The process of converting this into slag is a slow one and interferes by its presence with the driving and rapid melting of the furnace. By removing it mechanically by means
111 of the liquid slag washing it out through a large opening it is the more quickly removed, giving room for fresh fuel. As it may be thus removed at every flushing, it keeps the hearth freer of such matter than if it was allowed to fall and pass off as liquid slag. With coke there is a less proportion of slate, and the pieces are quite small instead of being large as in the case of anthracite coal, and far more quickly on this account combined with the flux and converted into slag, and this interferes but slightly with the drawing or melting of the furnace. I might state that I have known instances where the small Lurmann slagging block has been removed in anthracite furnaces for the reasons given.

Q. 9. Are you acquainted with the mechanism used by the defendant herein?

A. I visited the furnaces of the defendant in 1880, and I then became acquainted with their mechanism and methods.

Q. 10. I now show you a model, "Exhibit Furnace," and I direct your attention to the portion of the model, "Exhibit Grittinger," I now hand you and ask you what it is.

A. To the best of my knowledge, it represents the front of the North Cornwall furnace.

Q. 11. Please state, referring to the two methods of operating blast furnaces about which you spoke in previous answer, which of those two methods was practiced by the defendants at the North Cornwall furnace.

A. It is practically the first method—the washing-out method.

Q. 12. I now show you a model showing a section of the devices now used by the defendant, in which model the water channels are shown in white, and I ask you whether or not such water circulation would have any effect whatsoever upon the flowing stream of molten slag and unfused impurities.

("Exhibit Cinder Flush" shown witness.)

A. In my opinion, the water would have no effect whatever upon the flowing of the slag.

112 Q. 13. Please state what you consider the device used by the defendant to be.

A. It is a modification of the open-hearth furnace, as they retain the tymp, side cheeks, and dam, the fore hearth being filled with brick instead of infusible clay or part clay and part brick, the method of discharging the slag through an opening large enough to admit the passage of large pieces of slate, bone, or unfused limestone resembling the method employed in the open-front furnace previously described more than the method of discharging the slag through the Lurmann patent.

Q. 14. You have referred to the Lurmann patent. Are you acquainted with the Asmus reissue No. 3204?

A. I have read it.

Q. 15. I read you the following statement therefrom: "The flow of the cooling water through the cinder block D is regulated for the purpose of controlling the discharge of the slag through it. By allowing much cooling water to circulate through its water channels or pipes the temperature of the block D is lowered sufficiently to allow a coating of slag to adhere and choke its discharge openings, which are of less diameter in the middle than at their ends. By reducing the flow of cooling water the cinder block is allowed to retain a higher temperature, and in consequence the slag is melted out of the discharge openings and they become clear and open and permit the slag to flow without interruption." I want to know whether or not such an action is possible with the defendant's structure, as you understand it.

A. No; decidedly no.

Q. 16. Do you find in the defendant's structure any cinder block having the capacities of the one referred to in the quotation in my last question?

A. Assuming that "Exhibit Grittinger" correctly represents the defendant's structure, I would say no.

Cross-examination by Mr. KERR:

(The counsel for complainant objects to the above depo-
113 sition as incompetent in so far as it purports to define the Lurmann invention and what constitutes the use of the same.)

X Q. 17. In your answer to interrogatory 12 do you refer to the same matter that is contained in the quotation in question 15, viz., the chilling effect of the water upon the molten slag passing through the cinder notch?

A. By "effect" in my answer to the question I mean that the water circulation as shown by the model would not chill the slag, so as to affect the rapidity of its flow.

X Q. 18. Please state whether or not the Warwick Iron Company is a defendant in suit by this complainant for an infringement of this patent.

A. Yes, sir.

EDGAR S. COOK.

LEBANON, *February* 12, 1885.

P. L. Weimer.

Deposition of P. L. Weimer, taken on the part of defendant.

The witness P. L. WEIMER, being duly sworn, in answer to questions propounded by W. D. BALDWIN says as follows:

Q. 1. What is your name, age, residence, and occupation?

A. My name is P. L. Weimer; my age is 55 years; my residence is Lebanon, Pa., and I am by occupation a manufacturer of blast-furnace machinery.

Q. 2. For how long have you been practically familiar with the operation of blast furnaces?

A. I have given special attention to the operation of blast furnaces since 1856.

Q. 3. Are you familiar with the working of a blast furnace smelting ores?

A. I am, and have been for 29 years.

Q. 4. Will you briefly explain the process, particularly that part which relates to the formation of cinder?

114 A. In the manufacture of pig-iron the raw material, iron ores, fuel, and necessary fluxing material, generally limestone, are charged into the top of the furnace in fixed proportions. This material, in its descent through the furnace, is acted on by the ascending blast. The iron ore, in its conversion into metallic iron, throws off its gangue, which gangue unites with the flushing material and ashes of the fuel, forming a liquid slag or cinder, which passes the tuyeres into the crucible, from whence it is removed in various ways.

Q. 5. Is there any other material passing into the crucible of the furnace except this slag?

A. Yes; fuel, molten iron, and solid foreign matter obtained from the ores, flux, and fuel that has not liquified.

Q. 6. In what manner is the liquid cinder removed from the crucible of the furnace?

A. The older practice is to draw it off at stated intervals through an aperture made through a clay stopping in the hearth of the furnace. Mr. Lurmann has a patented device for drawing the liquid cinder either in a constant flowing stream or at intervals. Mr. Grittinger also has a patented device for drawing away both the liquid cinder and foreign solid material at stated intervals.

Q. 7. Are you familiar with Mr. Lurmann's device for drawing away cinder? If so, please describe it.

A. Mr. Lurmann's device consists of a hollow metallic block with an aperture through its centre, through which the liquid cinder is drawn while water is allowed to circulate through the block.

Q. 8. Where is this water-cooled block of Mr. Lurmann located in the furnace?

A. Immediately under the tymp and as near the interior wall of the crucible as possible.

Q. 9. What is the size of the aperture in Mr. Lurmann's device?

A. The aperture through which the cinder flows varies in size from one inch to two or two and one-half inches in diameter.

115 Q. 10. Are you familiar with Mr. H. C. Grittinger's device for drawing cinder from a blast furnace? If so, please describe it.

A. Mr. Grittinger's device consists of a horseshoe-shaped opening made in the tymp of the furnace, in front of which is placed a heavy casting of a shape to correspond with the horseshoe opening in the tymp. This coating is almost twenty inches in length, and has an aperture of the area of one hundred square inches. It is provided with an iron gate or stopper for closing the aperture when not in action. When sufficient cinder has accumulated in the crucible of the furnace Mr. Grittinger suddenly opens this large aperture of 100 square inches and allows the cinder to flow out with violence, carrying with it the solid foreign material that has passed tuyeres. As some iron ores throw off large quantities of this solid matter, Mr. Grittinger's device allows it to flow away with the liquid cinder and avoids it accumulating in the bottom to be more slowly dissolved and pass away, as with Mr. Lurmann's device, or being shovelled off at stated intervals, in accordance with the older practice.

Q. 11. Is it practical to accomplish the removal of solid matter, such as Mr. Grittenger flows away with his 100 square — area of opening, through Mr. Lurmann's device?

A. No. By the Lurmann process it must remain and dissolve in the liquid cinder before it can pass through the small aperture he provides.

Q. 12. Where does Mr. Grittinger's mode of removing the cinder and foreign material differ from the older furnace practice of doing this work?

A. In the older practice the cinder was drawn at stated intervals through a comparatively small orifice, similar in size to that now employed by Mr. Lurmann, while at fixed times the opening was greatly enlarged so as to admit of a large shovel being introduced, by means of which the foreign material was removed. Mr. Grittinger's differs from the fact that his opening is sufficient to

116 remove all foreign matter along with the cinder, and the violence of flow in such a large aperture is sufficient to accomplish all that was performed with the old practice of shovelling off.

Q. 13. What is the fore hearth of a furnace?

A. The fore hearth is a passage that leads from the outside of the furnace into the crucible, and from which, in ordinary practice, the cinder and iron is drawn.

Q. 14. Does Mr. Lurmann use a fore hearth?

A. No. He draws both iron and cinder direct from the crucible of the furnace; his dam is directly under his tymp.

Q. 15. Does Mr. Grittinger's cinder-drawing device and iron tap draw their stock away from a fore hearth?

A. The cinder device is placed outside of the tymp and dam sufficiently far back to accommodate the cinder device, both of which arrangements demand a fore hearth.

No cross-examination.

P. L. WEIMER.

LEBANON, *February* 11, 1885.

Counsel present: Mr. T. B. Kerr, for complainant, and Mr. William D. Baldwin, for defendant.

Henry L. Breevort.

HENRY L. BREEVORT, a witness produced on the part of the defendant, having been duly sworn, deposes and says:

Q. 1. What is your name, age, residence, and occupation?

A. My name is Henry L. Breevort; I am 36 years of age; I live in Brooklyn, N. Y., and am by profession a mechanical engineer.

Q. 2. What experience have you had in the practice of your profession, and have you ever been called upon to testify as an expert in suits relating to patents, and what knowledge have you of the subject-matter of this suit?

A. When a boy of seventeen I entered a machine shop,
117 where I acquired a general knowledge of mechanical operations and structures. After this I owned and operated for some years a small machine shop of my own. When I gave up this I was employed principally in designing machinery and in making tests of engines and other machines. About ten years ago I began to be frequently called upon to testify as an expert in suits relating to patents and patented devices, and since then almost my entire time has been thus occupied. I have been called upon to testify in upwards of three hundred cases. I am familiar with the subject-matter to which this case relates, and have seen a number of blast furnaces in operation.

Q. 3. Have you examined and do you understand that which is shown and described in the original letters patent No. 70447, granted November 5, 1867, to F. W. Lurmann for improvement in blast furnaces, a printed copy of which is now shown you?

A. Yes; I have examined the patent referred to in the question and I understand what is there shown and described.

Q. 4. Have you examined and do you understand what is shown, described, and claimed in the reissue of the said patent granted to George Asmus, No. 3204, dated November 24, 1878, the said Asmus

being the assignee of F. W. Lurmann, a printed copy of which reissue is now shown you?

A. Yes; I have examined the said reissue No. 3204, being, as I understand it, the complainant's patent in this case, and understand what is there shown, described, and claimed.

Q. 5. State whether you have read the testimony taken up to the present time in this case.

A. I have.

Q. 6. State what you understand to be the mechanism described and the operation of said mechanism as you understand it from examining Lurmann's original patent, and I call your attention specially to the first claim of the said patent.

118 A. Lurmann's original patent No. 70447 relates to an improvement in blast furnaces. The improvement, as I understand it, consists in discharging the slag or cinder and any impurities which may pass below the tuyeres as a liquid through what Lurmann calls "a slag-discharge piece." This consists of a block of metal having a small hole in it, through which the liquid slag and other melted impurities are to be constantly drawn from the interior of the furnace. This block, however, would not last long or be serviceable were it merely a piece of iron with a hole in it. So Lurmann's invention went further than this, and he describes that the block is to be cooled with water and so cooled that by passing water through the cavities of the block in large quantities the block can be so chilled that the cinder will be checked in its flow outward, and that in this way the amount of liquid material discharged can be regulated by regulating the quantity of water used in connection with the block. The block is also to be removable, so that a large opening may be readily obtained from the outside to the inside of the furnace. These are the capacities which Lurmann's cinder block are to possess.

He describes, in his specification, that the furnace is to be without a fore hearth or with a closed breast. Thus it is evident that it was his intention to reduce all foreign matters to a liquid and pass them out constantly through the hole in his cinder block. Lurmann nowhere describes how large the opening in his block is to be, but it is evident from the description that the opening is to be of such a size that water, when freely used in the cavities of the block, will cause the slag to congeal upon its surface to such an extent as to choke the discharge opening—that is to say, the water is to have the capacity of regulating the slag discharge. Now, it is evident that to achieve this result the opening must be one of small area, for if it were not the water could have no possible effect in regulating the slag discharge.

119 The common form of furnace before Lurmann's invention and the form largely used up to the present time had a fore hearth or open breast, and this large opening into the furnace was usually closed by an iron plate and stopping clay or other material. When the slag was to be discharged a small hole was made through the clay and the slag passed out through it, but when the foreign matter that had passed the tuyeres had accumulated in the bottom

of the furnace the front was opened and such matter removed with picks, bars, and shovels. Mr. Lurmann proposed to shut up this fore hearth and melt all the foreign matter that passed the tuyeres and pass it out through the small opening in his cinder block as a liquid, the stream being under the control of the water in the cavities of his cinder block.

The first claim of his original patent is as follows:

"1st. The slag-discharge piece D, constructed and arranged substantially as described."

From the foregoing it is clear what is here referred to. It is the block of metal having a small hole or holes in it, the openings being so small that water, when circulated in the cavities of the block, will control the discharge of materials through such opening. The block, however, must have another feature; it must be readily removable, thus leaving a large opening to work through; it must be constructed and "arranged" as described, and part of the necessary arrangement is that the block should be capable of being readily removed from the opening in the furnace which, when in use, it occupies. So far as the claim goes, the conditions of the invention would be satisfied if this piece were used with a furnace having an open front, or, as it is more commonly called, a "fore hearth." There is no limitation in the claim to the use of such a block, only in connection with a furnace having a closed front, and the closed front is nowhere mentioned in the claims.

Q. 7. Please state what you understand to be the mechanism described in the first and second claims of the Asmus reissue, No. 3204, dated November 24th, 1868.

120 A. The reissue describes in the specification substantially the same thing as is described in the original patent, though it uses different terms. The drawings in the reissue are the same as the drawings in the original patent. The claims have, however, been altered. Referring to the 2d claim of the reissue, I find that it is the same in terms as the first claim of the original, consequently I suppose that it refers to the same thing defined, as I understand it, fully in my last answer.

The first claim of the reissue does not appear in the original patent at all, and it is something new inserted in the reissue intended to cover combinations which the claims of the original patent were unable to embrace.

The first claim of the reissue is as follows:

"A blast furnace with a closed breast, where the slag is discharged through an opening or openings cooled by water, substantially as set forth."

Here we find a new combination, that of a furnace with a closed breast and a slag-discharge opening cooled by water. Now, this slag-discharge opening must be the slag discharge piece of the second claim and it must be cooled in the same way and the water must be capable of performing the same function of controlling the slag flow.

I fail to see that any combination rightfully exists between a particular form of furnace and a slag-discharge block, which, according

to the original first claim and indeed the second claim of the reissue, might be used with a furnace having an open breast.

However, the first claim of the reissue accentuates the fact that (at least, in the reissue) it was Lurmann's idea that the slag and unmelted foreign matter must all in a liquid state be passed out of the small opening in the slag-discharge piece, thus limiting Lurmann's invention and confining it to a particular method of making iron and discharging his slag and foreign matter as a liquid, and not, as in the old practice, partly as liquid and partly solid materials.

121 This is, in fact, the departure that Lurmann made in the art. He liquifies all the materials discharged from his furnace and takes them out as liquids.

The function of the slag block might be the same if combined with an old open-front furnace, the slag being drawn through it while the solid foreign matter was removed through the fore hearth, the only difference being that in such an arrangement the block would not have passed through its hole or holes the liquified foreign matter, but its functions, so far as slag goes, would be the same.

It is manifest that the Lurmann opening cooled by water cannot be any opening; for if such a broad interpretation be put upon the invention, then it can with justice be said that in every old furnace the slag was discharged through an opening cooled by water, for the tymp, the side cheeks, and the dam of old furnaces were cooled by water, and they formed an opening through which the slag was drawn. Now, it is evident that this is not Lurmann's invention, for the reason that the water used is so far from the stream of slag as not to have any controlling influence upon its flow. Thus it is clear that Lurmann must be limited to an opening of such a size that water circulated around the opening can be used to control the flow of slag.

Q. 8. Please give, briefly, your understanding of the construction and operation of an open-front furnace.

A. I can best give my understanding of the construction of an open-front furnace by referring to the "Exhibits Open-Hearth Furnace," which clearly shows the construction of such a furnace front in cross-section.

Now, I understand that the operation of such a furnace was substantially as follows: When it became necessary to remove the cinder a small opening was made between the front edge of the weight plate and the top of the dam. Through this opening the cinder found its way from the interior to the exterior of the furnace. At different times during the twenty-five hours, usually once and

122 sometimes twice, the weight plate was removed and the accumulation of foreign matter in the fore hearth was removed. In such furnaces it was thought to be the best practice not to melt up the foreign matter which passed the tuyeres and pass it away as a liquid with the slag, as Lurmann does; but, on the other hand, such matters were taken out of the fore hearth of the furnace when the same was opened for this purpose. I understand that it was usual always to tap the slag before the front of the furnace was opened. With such a furnace the slag, when it was flowing out, issued from

an opening the margins of which were cooled with water, to wit, the dam, the tymp, and the two side cheeks. The water, however, had no effect in controlling the stream of molten slag, for it was too far removed from the streams of slag to have any appreciable effect upon it.

Q. 9. Please state whether or not you understand that Lurmann was the first to suggest the possibility of removing the slag through a comparatively small opening.

A. He was not. Everybody knew that comparatively a small opening would serve to remove the slag through. Indeed, the opening in an old open-front furnace was comparatively small approximating to the size of the Lurmann opening.

Referring to the English patent of Dalton, No. 1000 of 1855, I find a smelting furnace shown in which the iron is drawn from a hole in the furnace near the bottom, while the slag is tapped through a hole above. This furnace has no open fore hearth. The patent shows that the broad idea of removing the slag through a small hole in a furnace without a fore hearth was not new with Lurmann. It is true that the Dalton furnace differs in shape and somewhat in mode of operation from Lurmann's furnace, but so far as the tapping of slag goes there is no material difference in that; both take the slag out through a small hole in a furnace which has no fore hearth.

123 Q. 10. Please state whether you do or do not understand the construction of the defendant's furnace so far as the parts are concerned which are used for the removal of the slag.

A. I do. I have seen all the furnaces in controversy and have seen the slag tapped from each of them, and I think that I understand the construction of the parts, taking into consideration the deposition of Henry C. Grittinger, which I have read, and in which deposition is explained the parts which were not visible to the eye.

Q. 11. Please compare the combinations and mechanical devices recited in the first and second claims of the Asmus reissue No. 3204 with the cinder-flushing devices used by the defendant and state whether or not you find in the said defendant's device the combinations and mechanical devices which are pointed out and claimed in the first and second claims of the said Asmus reissue No. 3204.

A. I have carefully made the comparison called for in the question, and I am clearly of the opinion that the defendant's device does not contain the combinations or the mechanical devices which are recited in the first and second claims of the Asmus reissue.

In giving my reasons for this opinion I will first state what I understand to be the structure used by the defendant. The defendant's structures are blast furnaces. They are used to smelt iron, but flush the cinder in a way very much like the old open-hearth method and utterly unlike Lurmann's method. Referring to the sectional model of the defendant's structure, it will be seen that a large arch-shaped tunnel leads from the interior of the furnace to the front thereof, an opening being made in the tymp for the purpose and of the shape desired. This tunnel is lined with coal dirt and

slag. This tunnel is not a water-cooled aperture, the only water that is used being that which is in the tymp and in the dam, the water in these parts being used, located, and circulated as was always done in the old furnaces, the only difference being that a recessed
124 dam is used, which has nothing to do with the cinder-tapping arrangements whatsoever. The use of the water in no way affects the flow of the slag to retard it or regulate its flow.

First of all, no amount of water which could be practically used would in use control a mass of molten slag as large as is allowed to flow through the defendant's flushing tunnel; second, as the water is used the only part of the tunnel cooled is so small as not to amount to a cooling at all.

When the slag is flushed with the defendant's device the front of the tunnel is opened, the stopping is removed, the blast is put on, and the slag, combined with such matters as are not fused, is violently ejected from the furnace through the tunnel, which, after the flush is stopped, is again closed, and the work of the furnace is proceeded with.

The blast is slacked before the tunnel is opened, and while it is being opened and while it is being closed it is thrown off. No attempt is made with defendant's device to fuse those matters which are not readily melted, but, as in the case of the old open-hearth furnace, the unfused materials are ejected from the furnace.

The defendants use and have used brick slag tunnels interchangeably with their iron ones, showing that not even metal was necessary for their construction.

Now, comparing such structures with those of the first and second claims of the Asmus reissue, I find as follows: Referring to the second claim first, it is clear that the defendants have not got the block D, for they have not a block with a small hole through it for the slag to pass out, and they have no water circulation which is adapted or capable of controlling the stream of cinder through the block.

Neither is the defendant's tunnel capable of removal, thus leaving a large opening as Asmus describes, but, on the contrary, part of the tunnel is made up of a passage directly through the brick of
125 the furnace itself, and consequently there cannot be said to be, in the sense of Asmus, any cinder block whatsoever.

Turning now to the first claim, this is, as I have stated, a combination, so called, the first element being a furnace with a closed breast, and the second element is an opening cooled by water.

Now, as I have already said, this opening cooled by water is either the cinder block D or else it is something which the patent does not describe or show. Of course it cannot be this latter, but must be understood as referring to the only opening described or shown which is cooled by water, and that is the block D.

In comparison with the Asmus reissue the defendant's furnace is an open-front furnace, for through its cinder-discharge tunnel the materials not dissolved in the slag are discharged in the solid form.

It is clear that the defendants do not have the combination, so called, of the first claim of the reissue, for they have not a furnace with a closed breast in the sense of Asmus, and assuredly they have

not got the opening cooled by water, which is the second element of the claim.

It must also be borne in mind, and it is very important, the defendants do not operate their furnaces on the same plan as is essential with the Asmus arrangement, which can only be used when the solid foreign matter is allowed to dissolve in the slag before it is ejected from the furnace.

Thus I am clearly of the opinion that the defendant's structures do not contain either the invention of the first or second claim of the Asmus reissue.

Q. 12. Can you produce a model illustrating the Asmus invention?

A. I can. It is now in evidence, marked "Exhibit Lurmann." This wooden model shows a vertical cross-section of the Asmus device as shown in the drawings of the reissue.

The cinder block is shown with the water circulating around the small slag-discharge hole, which, it can readily be seen,
126 would be kept cool thereby, thus giving a practical control of the stream of slag by means of the water used. I am informed that in practice the diameter of the hole in the Asmus cinder block is about one and a half inches, thus giving an area in cross-section of from nearly one to one and a third inches. Now, with the defendant's structures the area is never less than fifty square inches, and sometimes it runs up to about two hundred square inches.

It can be readily seen that the mere ring of water surrounding in part the tunnel where it passes the tymp could have no appreciable effect upon this enormous body of molten material.

In the model the water spaces are painted white, the iron portions black, and the brick portions yellow. The little hole in the block is also painted yellow in default of a better color for this part.

Q. 13. It has been stated by one of the witnesses called on the part of the defendant that it was his practice when the fore hearth was stopped up to flush his cinder through one of the tuyeres. You have read the testimony, I believe; if so, please compare this method of operating a furnace with the first claim of the Asmus reissue and state what similarity or dissimilarity you find. The witness I refer to is David Campbell.

A. Yes; I heard the testimony of Campbell taken in this case, and I understand what he describes concerning the use of one of the tuyeres of the furnace for discharging the slag. Of course, if the aperture cooled by water of the first claim of the Asmus reissue is any aperture, then the old use described by Campbell would show the invention, for at the time he used the tuyere the furnace had practically a closed breast and the slag was discharged through an aperture cooled by water, but in this case, as in the case of the defendants, the water could have exercised no control over the slag discharged, and consequently I am of the opinion that such
127 old use by Campbell did not show the Asmus invention as I understand that invention, for it is necessary to the Asmus invention that the aperture cooled by water should be of such a form and the water should be so applied that control of the stream

of slag can be obtained by means of the flow of water in the channels or cavities of the block through which the slag flows out.

Q. 14. Will you please look at the paper I now show you and state what it is?

A. It is a page from the Engineering and Mining Journal, dated February 5, 1876, containing an article by George Asmus on the subject of blast furnaces.

(Defendant's counsel offers the same in evidence, and it is marked "Defendant's Exhibit Asmus Paper.")

Adjourned till 10 a. m., February 12, 1885, same place.

FEBRUARY 12, 1885—10 a. m.

Met pursuant to adjournment.

Present: Same counsel as yesterday.

Examination of HENRY L. BREVOORT resumed:

Q. 15. Will you please state what you understand to be the mechanical devices described and claimed in the sixth claim of the Asmus reissue, No. 3204?

A. The sixth claim is as follows: "Combining with the metallic plate C a series of water channels or pipes, substantially as and for the purposes set forth."

The specification assigns no useful function or functions to the plate C, and merely describes that it is kept cool by water circulating in pipes or channels running through the plate.

No particular position is assigned for the plate. I quote from the specification:

"In the drawing, the plate C is shown above the cinder block, but it may also be placed below or in any other desirable position in relation to the same."

Thus it is evident that the position of the plate is no part of the invention.

128 It is also clear that it is no part of the invention of the sixth claim to combine such a plate with the particular cinder block of Asmus, for I quote as follows: "The plate C is also cast or made with channels or pipes running through it, and the channels or pipes of said plate and of the cinder block D may be so arranged as to connect or communicate with each other when the plate C and cinder block D are in their proper position, or they may be independent of each other."

From the above it is clear that the cinder block is no part and cannot be brought in as a part of the combination of the sixth claim.

The only understanding I can get of the sixth claim is that it is for a water-cooled tymp—that is, a water-cooled plate placed upon the walls of the furnace—when the walls are comparatively thin the water circulating in the plate serving to preserve it, and the plate, in its turn, serving to preserve the walls of the furnace.

Q. 16 Please examine Defendant's "Exhibit Bryant Patent" and "Exhibit Percy," also Defendant's "Exhibit Open Hearth," and

state whether or not you find in these exhibits anything which shows the invention of the sixth claim of the Asmus reissue, No. 3204.

Referring first to the Bryant patent, I find there shown a blast furnace which has around the crucible of the furnace water casings which are to absorb the heat and thereby increase the durability of the crucible. These water jackets are to have fresh water constantly flowing into them, so that they are kept cool. The specification of this patent is divided into various heads, which are numbered, and I call attention to the fifth head, which fully describes the extended water jackets. This description in the Bryant patent fully, in my judgment, shows the invention of the sixth claim of the Asmus reissue. It describes his plates, which are the same as the plate C, and they are described as cooled by currents of water which circulate in them. Figures 5 and 6 show the water jackets as used in connection with the tuyeres.

129 Defendant's "Exhibit Percy" describes a blast furnace and a tymp which is water-cooled. I quote from the description accompanying the drawing:

"Immediately under this arch is fixed the tymp itself, which is a long rectangular casting of iron containing in its interior a wrought-iron tube through which cold water is kept circulating." See figures 47, 48, and 49.

Then follows a description of how to make a tymp of this discription, which it is unnecessary to quote. Turning to the drawings which accompany the description, I find the water-cooled plate or tymp fully shown, with the water-circulating pipes cast therein. The tymp is of a shape slightly different from the tymp of the Asmus reissue, but this fact is, I should think, immaterial, for the tymp used in defendant's furnace, and which is said to be the equivalent of Asmus plate C, is of an entirely different shape from that plate. I think that Defendant's Exhibit Percy shows the entire invention contained in the sixth claim of the Asmus reissue. The plate is the same plate used in the same part of the furnace and water-cooled in the same way as the tymp of Asmus marked C, or the tymp used in the defendant's furnace. Referring next to Defendant's "Exhibit Open Hearth," I find that this exhibit has a tymp substantially identical with that used by the defendant and which form of tymp is, I believe, exceedingly old and well known. All these old tymp plates were water-cooled and were used exactly as Asmus uses his tymp plate which he calls C in his patent. I am therefore of the opinion that Defendant's "Exhibit Open Hearth" clearly shows the entire invention of the sixth claim of the Asmus reissue.

Q. 17. I call your attention to the fact that Asmus in his reissue refers to water-cooling his slag piece and his plate C. Please state whether you find in the description of his patent or in the drawing any water-circulating arrangement.

A. I do not. In Fig. 4 of the drawing he shows some water channels in his cinder block, but so far as the drawings go

130 these are the only water channels shown. The specification

merely states that the parts are water-cooled, but does not describe anything as to how the channels are arranged or how the water which is to flow through them is controlled.

Q. 18. I call your attention to the following paragraph in the Asmus reissue:

"This invention can be easily applied by those skilled in the art to which it belongs to blast furnaces of the common construction by removing the fore hearth and closing the aperture left in the breast of the furnace under the tymp stone by inserting the plate C with the cinder block D."

What do you say as to the correctness of this statement?

A. I think that this statement is utterly untrue. If it was attempted to be put in practice the slag block would be where the iron notch should be and slag could not be drawn at all. In the drawings of the Asmus reissue the reverse of this statement is there shown. The plate C is placed against the tymp arch and not below the tymp stone.

HENRY L. BREVOORT.

Cross-examination waived.

131 *Comparison of Asmus' Original and Reissue Patents.*

(Parts in italics not in original; parts in brackets not in reissue.)

UNITED STATES PATENT OFFICE.

GEORGE ASMUS, of New York, N. Y., assignee of F. W. Lurmann.

Improvement in Blast Furnaces.

Specification forming part of Letters Patent No. 70447, dated November 5, 1867; *Reissue No.* 3204, *dated November* 24, 1868.

To all whom it may concern:

Be it known that [I] F. W. Lurmann, of Osnabruck, in the Kingdom of Prussia, [have] invented a new and useful improvement in blast furnaces, and I, *George Asmus, of the city, county, and State of New York, assignee of the said F. W. Lurmann*, do hereby declare [that] the following [is] *to be* a full, clear, and exact description thereof, which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawing, forming part of this specification, in which drawing—

Figure 1 is a vertical central section of a furnace [to which my improvement is applied] *built according to this invention.*

Fig. 2 is a horizontal section through the tuyeres.

Fig. 3 is a front elevation of the slag-discharge piece *or cinder block* detached.

132 Fig. 4 is a vertical section *thereof* [of the latter, also detached].

Similar letters indicate corresponding parts.

This invention relates to [furnaces for smelting iron ore, and has

for its object to dispense with the "tymp" or fore hearth and the "wall stone" now in common use in iron blast furnaces, and to replace the tymp arrangement by such a construction as allows the slag to]

certain improvements in blast furnaces with a closed breast; and it consists, principally, in a blast furnace with a closed breast, where the slag is discharged through an opening cooled with water in such a manner that the tymp or fore hearth and the wall stone can be dispensed with, and that the slag can be tapped directly from the hearth.

It consists, further, in a slag-discharge piece or "cinder block" of peculiar construction, as will be hereinafter more fully explained, whereby the building of a furnace according to this invention and its correct operation are materially facilitated.

In order to enable those skilled in the art to fully understand the object of this invention, I will first point out the disadvantages of blast furnaces with a fore hearth, such as are now in common use for melting iron ore.

In *such* [the tymp arrangement] *furnaces* the slag is driven out [of the furnace] by first being forced below the tymp stone, which projects below the level of the tuyeres and intercepts the currents of air and prevents their escape with the slag which stands in the [tymp] *fore hearth* at the same lever as on the hearth, the slag being discharged only when it rises in the [tymp] *fore hearth* high enough to overflow the top of the wall stone that forms the bottom of the discharging orifice.

By this arrangement the tymp stone constitutes a trap which intercepts the currents of air and causes their pressure to be exerted directly on the surface of the slag on the hearth.

This method of construction has several disadvantages, one
133 of which is the difficulty of keeping the tymp stone and the surrounding parts in repair; another is that the pressure of the currents of air or wind is limited [and counteracted] by the counter-pressure of the column of slag in the [tymp] *fore hearth*, and another is that, one side of the furnace being occupied by the *fore hearth*, no tuyere can be applied on that side, and consequently the supply of wind is irregularly distributed.

By the improvement which constitutes the subject-matter of this present invention these disadvantages are overcome

[My invention avoids or overcomes these disadvantages] in a simple and effective manner.

In [this example of my invention] *the drawings* the letter A designates the furnace, and B several tuyeres, which are arranged therein at a proper height.

The furnace is constructed with a closed breast,

[My furnace has no tymp] and the sides of the hearth, whether round or square, extend clear down to the bottom stone, the usual opening, not shown in the drawing, being made in the lower part of the hearth for the discharge of the iron. The openings for the tuyeres B are distributed at equal distances apart in the sides of the hearth.

At a suitable height from the bottom stone [I leave] an opening *is left* in the hearth, in which [I place] *is placed* a cast-iron or brass

slag-discharge piece or *cinder block*, *D*, which is cast or made with numerous channels or pipes running up and down or in other directions through it, as shown in Figs. 3 and 4.

The *cinder block* [piece] D [is] *may be* formed with a dovetail on its upper end, which is fitted into the bottom of a stationary metallic plate, C, connected with the furnace, *or it may be attached to said plate in any other desirable manner, or cast solid with the same, if desired.*

The plate C is also cast or made with channels or pipes running through it, and the channels or pipes of said plate and of the *cinder block* [piece] D may be so arranged as to connect or communicate with each other when the plate C and *cinder block* [piece] D are in their proper position, or they may be independent of each other.

134 *In the drawing the plate C is shown above the cinder block, but it may also be placed below or in any other desirable position in relation to the same.*

The object of the [said] channels or pipes is to permit the plate C and *cinder block* [piece] D to be cooled by forcing water through them while the furnace is in operation, proper connections being made for that purpose with a reservoir of cold water or with a force-pump.

One or more holes are made in the [said piece] *cinder block* D, through which the slag is discharged, the shape of said holes being shown in Figs. 3 and 4, the middle portion being cylindrical, but each end being conical or flaring.

The dimensions of the [slag-discharge piece] *cinder block* are a little less than the opening in which it is placed and the space left around it is filled with sand, which can be readily removed in case it is desired to remove the block D to repair it or if it — desired to have an opening in the hearth to work through, as when any irregularity in the smelting process has taken place.

The flow of the cooling water through the [slag-discharge piece] *cinder block* D is regulated for the purpose of controlling the discharge of the slag through it.

By allowing much cooling water to circulate through its water channels or pipes the temperature of the *block* [piece] D is lowered sufficiently to allow a coating of slag to adhere and choke its discharge openings, which are of less diameter in the middle than at their ends.

By reducing the flow of cooling water the *cinder block* [piece] is allowed to retain a higher temperature, and in consequence the slag is melted out of the discharge openings and they become clear and open and permit the slag to flow without interruption.

When the slag in the hearth is [lower than] *below* the level of the discharge openings the latter are simply closed by an iron *plug* [rod].

[My] *this* invention can be easily applied by those skilled
135 in the art to which it belongs—to blast furnaces of the common construction—*by removing the fore hearth and closing the aperture left in the breast of the furnace under the tymp stone by inserting the plate C with the cinder block D.*

[This invention is attended with several advantages over the com-

mon method of constructing or arranging furnaces, among which I mention the following:]

The principal advantages derived from this invention are as follows:

First, it permits a higher pressure of wind.

Second, the hearth is preserved in better condition than where the common mode of construction is retained.

Third, the labor of the operation of smelting is lessened.

Fourth, it allows one more side of the hearth for a tuyere.

Fifth, it avoids the stoppages of the wind supply now necessary as often as the iron is discharged.

Sixth, a considerable increase is gained in the product of the furnace, while at the same time the cost of labor and repairs is lessened.

Having thus described this invention,

What I claim as new, and desire to secure by letters patent, is—

1. *A blast furnace with a closed breast, where the slag is discharged through an opening or openings cooled by water, substantially as set forth.*

[1.] 2. The slag-discharge piece or *cinder block* D, constructed and arranged substantially as described.

[2.] 3. The [slag-discharge piece] *cinder block* D, in combination with the plate C, to which it is attached, substantially as described.

[3.] 4. The shape of the discharge opening or openings of the *cinder block* [piece] D, being made flaring at its ends and of diminished diameter in the middle or central part, substantially as described.

[4.] 5. *The* combining [with] *of* the slag-discharge piece *or cinder block with* a series of water channels or pipes, substantially as and for the purpose above set forth.

136 [5.] 6. Combining with the metallic plate C a series of water channels or pipes, substantially as and for the purpose set forth.

[6.] 7. The method of controlling the discharge of slag from blast furnaces by regulating the temperature of the slag-discharge piece or *cinder block*, substantially as described.

This specification signed by me this [twelfth day of July, 1867] 24*th day of October*, 1868.

[F. W. LURMANN.] *George Asmus.*

Witnesses:

[A. STEINHOFF.] *W. Hauff.*
[E. SCHEMANN.] *Ernest F. Kastenhuber.*

137 UNITED STATES PATENT OFFICE.

GEORGE ASMUS, of New York, N. Y., assignee of F. W. Lürmann.

Letters Patent No. 70447, dated November 5, 1867; Reissue No. 3204, dated November 24, 1868.

Improvement in Blast-Furnaces.

The schedule referred to in these letters patent and making part of the same.

To all whom it may concern:

Be it known that F. W. Lürmann, of Osnabrück, in the Kingdom of Prussia, have invented a new and useful improvement in blast-furnaces; and I, George Asmus, of the city, county, and State of New York, assignee of the said F. W. Lürmann, do hereby declare the following to be a full, clear, and exact description thereof, which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawing, forming part of this specification, in which drawing—

(Here follows diagram marked p. 139.)

Figure 1 is a vertical central section of a furnace built according to this invention.

Figure 2 is a horizontal section through the tuyeres.

Figure 3 is a front elevation of the slag-discharge piece or cinder-block, detached.

Figure 4 is a vertical section thereof.

Similar letters indicate corresponding parts.

This invention relates to certain improvements in blast-furnaces with a closed breast; and

It consists, principally, in a blast-furnace with a closed breast, where the slag is discharged through an opening cooled with water in such a manner that the tymp or fore-hearth and the wall-stone can be dispensed with, and that the slag can be tapped directly from the hearth.

It consists, further, in a slag-discharge piece or "cinder-block," of peculiar construction, as will be hereinafter more fully explained, whereby the building of a furnace according to this invention, and its correct operation, are materially facilitated.

In order to enable those skilled in the art to fully understand the object of this invention, I will first point out the disadvantages of blast-furnaces with a fore-hearth such as are now in common use for melting iron-ore.

In such furnaces the slag is driven out by first being forced below the tymp stone, which projects below the level of the tuyeres, and intercepts the currents of air, and prevents their escape with the slag, which stands in the fore-hearth at the same level as on the hearth, the slag being discharged only when it rises in the fore-

F. W. LURMANN.

Blast Furnace.

No. 3,204. No. 323 Freeman v. Asmus. } p. 139. Reissued Nov. 24, 1868.

Fig. 3.

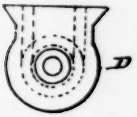


Fig. 4

Fig. 1

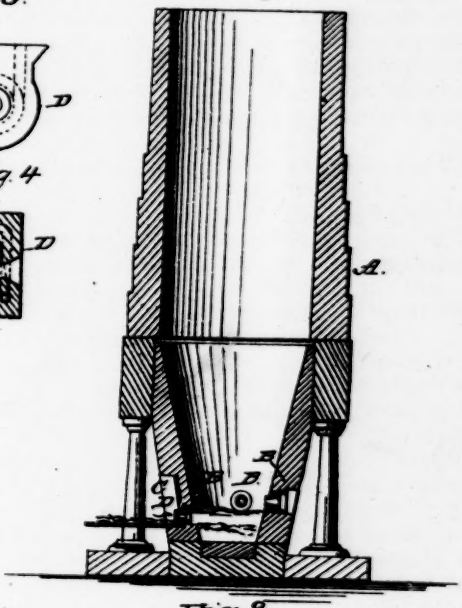
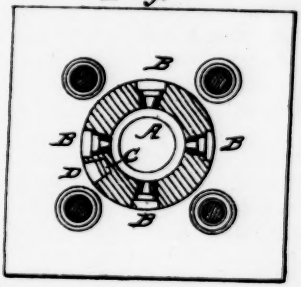


Fig. 2



WITNESSES:
Gustav Berg
Geo. B. Southard

INVENTOR.
F. W. Lurmann
by Van Santvoord & Hauff

hearth high enough to overflow the top of the wall-stone that forms the bottom of the discharging-orifice.

By this arrangement the tymp-stone constitutes a trap, which intercepts the currents of air, and causes their pressure to be exerted directly on the surface of the slag on the hearth.

This method of construction has several disadvantages, one of which is the difficulty of keeping the tymp-stone and the surrounding parts in repair; another is that the pressure of the currents of air or wind is limited by the counter-pressure of the column of slag in the fore-hearth; and another is that one side of the furnace, being occupied by the fore-hearth, no tuyere can be applied on that side, and consequently the supply of wind is irregularly distributed.

By the improvement which constitutes the subject-matter of this present invention, these disadvantages are overcome in a simple and effective manner.

In the drawings, the letter A designates the furnace, and B several tuyeres, which are arranged therein at a proper height.

The furnace is constructed with a closed breast, and the sides of the hearth, whether round or square, extend clear down to the bottom stone, the usual opening (not shown in the drawing) being made in the lower part of the hearth for the discharge of the iron.

The openings for the tuyeres B are distributed at equal distances apart in the sides of the hearth.

At a suitable height from the bottom stone an opening is left in the hearth, in which is placed a cast-iron or brass slag-discharge piece or cinder-block, D, which is cast or made with numerous channels or pipes, running up and down, or in other directions through it, as shown in Figs. 3 and 4.

The cinder-block D may be formed with a dovetail on its upper end, which is fitted into the bottom of a stationary metallic plate, C, connected with the furnace, or it may be attached to said plate in any other desirable manner, or cast solid with the same, if desired.

The plate C is also cast or made with channels, or pipes running through it, and the channels or pipes of said plate, and of the cinder-block D, may be so arranged as to connect or communicate with each other when the plate C and cinder-block D are in their proper position, or they may be independent of each other.

In the drawing, the plate C is shown above the cinder-block, but it may also be placed below, or in any other desirable position in relation to the same.

The object of the said channels or pipes is to permit the plate C and cinder-block D to be cooled by forcing water through them while the furnace is in operation, proper connections being made for that purpose with a reservoir of cold water, or with a force-pump.

One or more holes are made in the cinder-block D, through which the slag is discharged, the shape of said holes being shown in Figs. 3 and 4, the middle portion being cylindrical, but each end being conical or flaring.

The dimensions of the cinder-block are a little less than the opening in which it is placed, and the space left around it is filled with

sand, which can be readily removed in case it is desired to remove the block D to repair it, or if it is desired to have an opening in the hearth to work through, as when any irregularity in the smelting-process has taken place.

The flow of the cooling-water through the cinder-block D is regulated for the purpose of controlling the discharge of the slag through it.

By allowing much cooling-water to circulate through its water-channels or pipes, the temperature of the block D is lowered sufficiently to allow a coating of slag to adhere and choke its discharge-openings, which are of less diameter in the middle than at their ends.

138 By reducing the flow of cooling-water, the cinder-block is allowed to retain a higher temperature, and, in consequence, the slag is melted out of the discharge-openings, and they become clear and open, and permit the slag to flow without interruption.

When the slag in the hearth is below the level of the discharge-openings, the latter are simply closed by an iron plug.

This invention can be easily applied, by those skilled in the art to which it belongs, to blast-furnaces of the common construction, by removing the fore-hearth and closing the aperture left in the breast of the furnace, under the tymp-stone, by inserting the plate C with the cinder-block D.

The principal advantages derived from this invention are as follows:

First, it permits a higher pressure of wind.

Second, the hearth is preserved in better condition than where the common mode of construction is retained.

Third, the labor of the operation of smelting is lessened.

Fourth, it allows one more side of the hearth for a tuyere.

Fifth, it avoids the stoppages of the wind-supply, now necessary as often as the iron is discharged.

Sixth, a considerable increase is gained in the product of the furnace, while at the same time the cost of labor and repairs is lessened.

Having thus described this invention,

What I claim as new, and desire to secure by letters patent, is—

1. A blast-furnace with a closed breast where the slag is discharged through an opening or openings cooled by water, substantially as set forth.

2. The slag-discharge piece or cinder-block E, constructed and arranged substantially as described.

3. The cinder-block D, in combination with the plate C, to which it is attached, substantially as described.

4. The shape of the discharge-opening or openings of the cinder-block D, being made flaring at its ends, and of diminished diameter in the middle or central part, substantially as described.

5. The combining of the slag-discharge piece or cinder-block with a series of water-channels or pipes, substantially as and for the purpose above set forth.

142

F. W. LURMANN.

Blast Furnace.

70,447. No. 323. Freeman v. Asmus. p. 142.

Patented Nov. 5, 1867

Fig. 1,

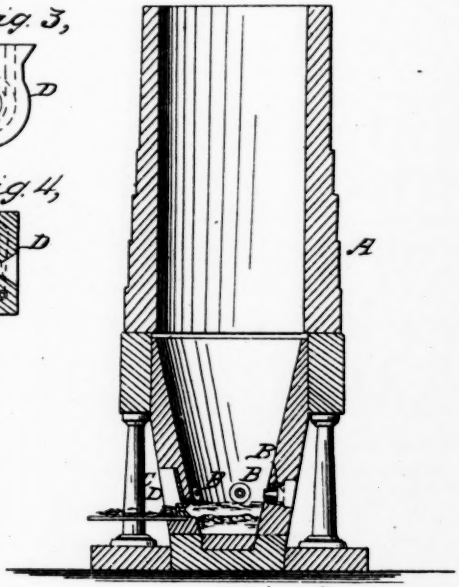


Fig. 3,

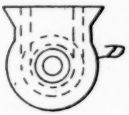
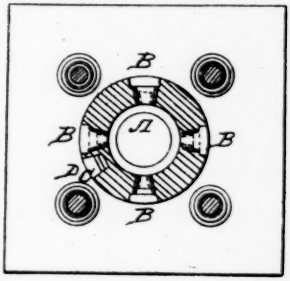


Fig. 4,

Fig. 2,



Witnesses:
Gustav Berg
Geo. F. Southard

Inventor.
F. W. Lurmann
by
Voss Lombard & Hoff

6. Combining with the metallic plate C a series of water-channels or pipes, substantially as and for the purpose set forth.

7. The method of controlling the discharge of slag from blast-furnaces by regulating the temperature of the slag-discharge piece or cinder-block, substantially as described.

This specification signed by me this 24th day of October, 1868.

GEORGE ASMUS.

Witnesses:

W. HAUFF.

ERNEST F. KASTENHUBER.

140 UNITED STATES PATENT OFFICE.

F. W. LÜRMANN, of Osnabruck, Prussia.

Letters Patent No. 70447, dated November 5, 1867.

Improvement in Blast-Furnaces.

The schedule referred to in these letters patent and making part of the same.

To all whom it may concern:

Be it known that I, F. W. Lürmann, of Osnabruck, in the Kingdom of Prussia, have invented a new and useful improvement in blast-furnaces; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawing, forming part of this specification, in which drawing—

(Here follows diagram marked p. 142.)

Figure 1 is a vertical central section of a furnace to which my improvement is applied.

Figure 2 is a horizontal section through the tuyeres.

Figure 3 is a front elevation of the slag-discharge piece detached.

Figure 4 is a vertical section of the latter, also detached.

This invention relates to furnaces for smelting iron ore, and has for its object to dispense with the "tymp" or fore-hearth and the "wall-stone" now in common use in iron blast-furnaces, and to replace the tymp arrangement by such a construction as allows the slag to be tapped directly from the hearth. In the tymp arrangement the slag is driven out of the furnace by being first forced below the tymp-stone, which projects below the level of the tuyeres and intercepts the currents of air, and prevents their escape with the slag, which stands in the tymp at the same level as on the hearth, the slag being discharged only when it rises in the tymp high enough to overflow the top of the wall-stone that forms the bottom of the discharging orifice. By this arrangement the tymp-stone constitutes a trap which intercepts the currents of air, and causes their pressure to be exerted directly on the surface of the slag on the

hearth. This method of construction has several disadvantages, one of which is the difficulty of keeping the tymp-stone and the surrounding parts in repair; another is, that the pressure of the currents of air or wind is limited and counteracted by the counter-pressure of the column of slag in the tymp; and another is, that one side of the furnace being occupied by the tymp, no tuyere can be applied on that side, and consequently the supply of wind is irregularly distributed.

My invention avoids or overcomes these disadvantages in a simple and effective manner.

In this example of my invention the letter A designates the furnace, and B several tuyeres, which are arranged therein at a proper height. My furnace has no tymp, and the sides of the hearth, whether round or square, extend clear down to the bottom stone, the usual opening (not shown in the drawing) being made in the lower part of the hearth, for the discharge of the iron. The openings of or the tuyeres B are distributed at equal distances apart in the sides of the hearth. At a suitable height from the bottom-stone I leave an opening in the hearth, in which I place a cast-iron or brass slag-discharge piece, D, which is cast or made with numerous channels or pipes, running up and down or in other directions through it, as shown in Figs 3 and 4. The piece D is formed with a dove-tail on its upper end, which is fitted into the bottom of a stationary metallic plate, C, connected with the furnace. This plate is also cast or made with channels or pipes running through it, and the channels or pipes of said plate and of the piece D may be so arranged as to connect or communicate with each other when the plate C and piece D are in their proper positions, or they may be independent of each other. The object of the said channels or pipes is to permit the plate C and piece D to be cooled, by forcing water through them while the furnace is in operation, proper connections being made for that purpose with a reservoir of cold water, or with a force-pump. One or more holes are made in said piece D, through which the slag is discharged, the shape of said holes being shown in Figs. 3 and 4, the middle portion being cylindrical, but each end being conical or flaring. The dimensions of the slag-discharge piece are a little less than the opening in which it is placed, and the space left around it is filled with sand, which can be readily removed in case it is desired to remove the piece D to repair it, or if it is desired to have an opening in the hearth to work through, as when any irregularity in the smelting process has taken place. The flow of cooling-water through the slag-discharge piece D is regulated for the purpose of controlling the discharge of the slag through it. By allowing much cooling water to circulate through its water-channels or pipes, the temperature of the piece D is lowered sufficiently to allow a coating of slag to adhere and choke its discharge openings, which are of less diameter in the middle than at their ends. By reducing the flow of cooling-water the piece is allowed to retain a higher temperature, and in consequence the slag is melted out of the discharge-openings, and they become clear and open, and permit the slag to flow without interruption. When the slag in the

hearth is lower than the level of the discharge-openings, the latter are simply closed by an iron rod.

141 My invention can be easily applied, by those skilled in the art to which it belongs, to blast-furnaces of the common construction.

The invention is attended with several advantages over the common method of constructing or arranging furnaces, among which I mention the following:

First. It permits a higher pressure of wind.

Second. The hearth is preserved in better condition than where the common mode of construction is retained.

Third. The labor of the operation of smelting is lessened.

Fourth. It allows one more side of the hearth for a tuyere.

Fifth. It avoids the stoppages of the wind supply, now necessary as often as the iron is discharged.

Sixth. A considerable increase is gained in the product of the furnace, while at the same time the cost of labor and repairs is lessened.

What I claim as new, and desire to secure by letters patent, is—

1. The slag-discharge piece D, constructed and arranged substantially as described.

2. The slag-discharge piece D, in combination with the plate C, to which it is fitted substantially as described.

3. The shape of the discharge opening or openings of the piece D, being made flaring at its ends, and of diminished diameter in the middle or central part, substantially as described.

4. Combining with the slag-discharge piece a series of water-channels or pipes, substantially as and for the purpose above set forth.

5. Combining with the metallic plate C a series of water-channels or pipes, substantially as and for the purpose above set forth.

6. The method of controlling the discharge of slag from blast-furnaces, by regulating the temperature of the slag-discharge piece, substantially as described.

This specification signed by me this twelfth day of July, 1867.

F. W. LÜRMANN.

Witnesses:

A. STEINHOFF.
E. SCHEMMANN.

143 "EXHIBIT ASSIGNMENT."

Whereas I, Fr. W. Lurmann, of Osnabruck, in the Kingdom of Prussia, Germany, am about to make application for letters patent of the United States for a new and useful improvement in blast furnaces, which invention is fully described in the specification pertaining to said application, which I have signed under oath:

Now, this indenture witnesseth: That, for and in consideration of the sum of one dollar, to me in hand paid, the receipt of which I

acknowledge, I do hereby sell, assign, and transfer unto George Asmus, of New York, in the county and State of New York, all the right, title, and interest in and to the said improvement and the letters patent thereof when granted, the same to be held and enjoyed by the said George Asmus — assigns as fully and entirely as the same would have been held and enjoyed by me if this assignment and sale had not been made.

Witness my hand and seal this twelfth day of July, 1867.

{ 5 cts. 5 | F. W. L. July 12th, 1867. | 5 cts. 5 }

F. W. LURMANN. [SEAL.]

Sealed and delivered in presence of—
E. SCHEMMANY.

Liber V 9, p. 123. Recorded Sept. 16th, 1867.

"EXHIBIT REISSUE FILE."

(2–175.)

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE.

To all persons to whom these presents shall come, Greeting:

This is to certify that the annexed is a true copy from the files of this office of the file-wrapper and contents in the matter of the reissue letters patent granted George Asmus, assignee of F. W. Lurmann, November 24, 1868, number 3204, for improvement in blast furnaces.

144 In testimony whereof I, Benj. Butterworth, Commissioner of Patents, have caused the seal of the Patent Office to be affixed this 12th day of April, in the year of our Lord one thousand eight hundred and eighty-four, and of the Independence of the United States the one hundred and eighth.

BENJ. BUTTERWORTH,
Commissioner.

[SEAL.]

NEW YORK CITY, *Nov.* 2, 1868.

Hon. Commissioner of Patents.

SIR: We have the honor to enclose the application of George Asmus for a reissue of F. W. Lurmann's improvement in furnaces; also the original patent and $30 fee.

Very respectfully,

VAN SANTVOORD & HAUFF.

Indorsed: Patent Office, Nov. 3, 1868, U. S. A.

Petition for Reissue.

To the Commissioner of Patents:

The petition of George Asmus, of the city, county, and State of New York, respectfully represents that he has, by grant duly recorded in

the Patent Office, become the owner of certain improvements in blast furnaces, for which letters patent were granted to F. W. Lurmann, of Osnabruck, Kingdom of Prussia, which letters patent are dated on the fifth day of November, 1867; that he now believes that the same is inoperative and invalid by reason of a defective specification, which defect has arisen from inadvertence and mistake. He therefore prays that he may be allowed to surrender the same and request that new letters patent may issue to him for the same invention for the residue of the period for which the original patent was granted, under the amended specification herewith presented, he having paid thirty dollars into the Treasury of the United States agreeably to the requirements of the act of Congress in that case made and
145 provided; and he hereby authorizes John Van Santvoord and W. Hauff, of the firm of Van Santvoord & Hauff, of the city of New York, or their accredited agents, to act as his attorneys in presenting the application and in making all such alterations and amendments as may be required.

{50 cts. G. A. Oct. 24, 1868. 50 cts.}

GEORGE ASMUS.

Oath.

COUNTY OF NEW YORK, *State of New York*, } ss:

On this 24th day of October, 1868, before the subscriber, a notary public in and for said county, personally appeared the above-named George Asmus and made solemn oath that he verily believes that, by reason of an insufficient or defective specification, the aforesaid patent is not fully valid and available to him, and that the said error has arisen from inadvertence, accident, or mistake, and without any fraudulent or deceptive intention, to the best of his knowledge and belief.

[L. S.]

W. HAUFF,
Notary Public.

Statement

Relating to the application of George Asmus for the reissue of letters patent granted to F. W. Lurmann for an improvement in blast furnaces, No. 70447, dated Nov. 5, 1867.

The errors and defects occurring in the original specification by inadvertence and mistake and sought to be corrected by this application for a reissue are as follows:

The invention, as described in the original specification and represented in the drawings, clearly comprises a blast furnace with a closed breast, where the slag is discharged through an opening or openings cooled with water, but the claim in the original specification is confined to a slag-discharge piece or cinder block constructed

and attached in a certain specific manner. It is obvious that
146 the cinder block D can be connected to or cast solid with the plate C without changing the nature of the invention, and in the new specification this defect has been corrected and a clause has been added to the claim with the view to cover the whole ground of the invention.

Very respectfully,

VAN SANTVOORD & HAUFF,
Att'ys for George Asmus.

New York, Oct. 30, 1868.

Indorsed: Patent Office, Nov. 3, 1868, U. S. A.

1868.

No. 3204. Reissue. 9773.

George Asmus, assignee of F. W. Lurmann,
Of New York,
County of New York,
State of "
Blast furnaces.
Rec'd Nov. 3, 1868.
Petition, " "
Affidavit, " "
Specification, " "
1. Drawing, " "
Old patent No. 70447, Nov. 5, 1867.
Cert. dep., —.
1. Cash, $30, Nov. 3, 1868.
Examined Nov. 6, '68, B. S. Hedrick.
2. Issue Grinnell, Nov. 7, '68.
3. Patented Nov. 5, 1867.
Reissued Nov. 24, 1868.
Van Santvoord & Hauff, New York, N. Y.
Wiedersheim & Co., associate, present.

NOTE.—For old patent see "Exhibit Lurmann Patent." For reissue see "Exhibit Complainant's Patent," complainant's record, and copy bound in this record.

147 "EXHIBIT DUNBAR SUIT."

In the Circuit Court of the United States for the Western District of Pennsylvania.

GEORGE ASMUS
vs.
DUNBAR FURNACE CO. *et al.* } No. 215. Nov. Term, 1877.

Equity Docket Entries.

GEORGE ASMUS
vs.
THE DUNBAR FURNACE COMPANY; CHARLES PARISH, Pres't, and A. B. DE SAULLES, Vice-President.

Bill filed October 17th, 1877.

Same day subpœna issued, returnable first Monday of December next.

1877, October 22.—Subpœna served personally and by copy upon A. B. De Saulles, vice-president of the Dunbar Furnace Company. N. E. I. as to Charles Parrish, president. M., $6.92.

1878, February 11.—Answer of respondents filed.

1878, February 15.—Replication of complainant filed.

1878, August 17.—On motion of complainant's counsel, order granted directing the respondents to close their testimony within twenty days from this date, and that the cause be fixed for hearing at the November term of this court. Order filed.

1878, August 19.—Depositions on part of complainant taken before R. H. Whittlesey, notary public, received and filed, the same having been taken before said notary public by agreement of counsel for the respective parties thereto.

November term, 1878.—The above cause came on to be heard, and was argued by counsel for the respective parties upon bill, answer, replication, and proofs and same taken under consideration by the court.

148 1879, March 7.—Decree filed allowing a decree to be entered for complainant and for an injunction and account against the respondents.

1879, March 11.—Decree sustaining the validity of complainant's patents, decreeing respondent company to have infringed the same, appointing H. D. Gamble master to take and report an account of the damages sustained by complainant, and allowing an injunction to be issued perpetually enjoining and restraining said respondents from any further infringement of complainant's said patents awarded and filed.

Bill.

Circuit Court of the United States in and for the Western District of Pennsylvania.

GEORGE ASMUS *versus* DUNBAR FURNACE CO.; CHARLES PARRISH, President, and A. B. DE SAULLES, Vice-President.	No. 215. November Term, 1877. In Equity.

To the honorable the judges of the circuit court of the United States in and for the western district of Pennsylvania:

George Asmus, of New York city, in the State of New York, and a citizen of said State, brings this bill against the Dunbar Furnace Company, a corporation existing under the laws of the State of Pennsylvania and having its principal place of business at Dunbar, in the county of Fayette, in the western district of Pennnsylvania aforesaid, Charles Parrish, president, and A. B. De Saulles, vice-president, thereof.

And thereupon your orator complains and says that on or before the 5th day of November, in the year one thousand eight hundred and sixty-seven, one F. W. Lurmann — the true, original, and first inventor of a certain new and useful improvement in blast
149 furnaces not known or used before and not for more than two years prior to the date of his application for a patent in public use or on sale with his consent or allowance.

And your orator further shows unto your honors that the said F. W. Lurmann, so being the inventor of said improvement and being a citizen of Prussia, made application to the proper department of the Government of the United States for letters patent in accordance with the then existing laws of Congress, and, having duly complied in all respects with the conditions and requisitions of said laws, on the fifth day of November, in the year one thousand eight hundred and sixty-seven, letters patent of the United States, in due form of law, under the seal of the Patent Office of the United States, signed by the Secretary of the Interior and countersigned by the Commissioner of Patents, bearing date the day and year last aforesaid and numbered No. 70447, were issued to the aforesaid F. W. Lurmann for his invention or discovery, whereby there were secured to him and to his heirs, executors, and assigns, for the term of seventeen years from the fifth day of November, in the year one thousand eight hundred and sixty-seven, the full and exclusive right of making, using, and vending to others to be used the said improvement.

And your orator further shows that a description or specification of the aforesaid improvement was given in the schedule to the aforesaid letters patent annexed, accompanied by certain drawings referred to in said last-mentioned schedule and forming part of said letters patent. The said letters patent and the said specification thereto annexed (which or an exemplified copy of which your

orator will produce as your honors may direct) were duly recorded in the Patent Office.

And your orator further shows unto your honors that the said original letters patent No. 70447 were assigned by an instrument in writing by said F. W. Lurmann to your orator, and that the
150 same, for good and lawful cause, having been surrendered to the Commissioner of Patents and application having been made for a reissue thereof, and the provisions of the act of Congress in such case made and provided having in all respects been complied with, new letters patent for the same invention for the residue of said term of seventeen years were issued to your orator, assignee of said F. W. Lurmann, in accordance with law, on the 24th day of November, 1868, and numbered reissue No. 3204, as by said last-mentioned letters patent or a duly authenticated copy thereof will fully appear.

And your orator further shows that a description or specification of the aforesaid improvement was given in the schedule to the said last-mentioned reissued letters patent annexed, accompanied by certain drawings referred to in said last-mentioned schedule and forming part of said last-mentioned reissued letters patent; that the said last-mentioned reissued letters patent and the specification thereto annexed (which or an exemplified copy of which your orator will produce as your honors may direct) were duly recorded in the Patent Office.

And your orator further shows that he has caused the said improvement to be extensively applied to practical use, and has been and but for the infringement hereinafter complained of your orator would still be in the undisturbed possession, use, and enjoyment of the exclusive privileges secured by the said letters patent and in receipt of the profits of the same.

And your orator further shows unto your honors, as he is informed and believes, that the said defendants herein named, well knowing all the facts hereinbefore set forth, are now constructing and using blast furnaces in some parts thereof substantially the same in construction and operation as in the said reissued letters patent mentioned, the exclusive right and privilege to make and use which and vend the same to others to be used is thus by law vested in your orator.

151 And so it is, may it please your honors, that the said defendants, as your orator is informed and believes, without the license of your orator, against his will, and in violation of his rights, have made and used and intend to continue still to make and use the said improvements within the western district of Pennsylvania, and refuse to pay to your orator any of the profits which they have made by such unlawful manufacture and use or to desist from the further infringement of said recited letters patent; all of which acts and doings are in violation of the exclusive rights and privileges so as aforesaid vested in your orator under and by virtue of said recited letters patent and are contrary to equity and good conscience and tend to the manifest injury of your orator in the premises.

To the end, therefore, that the defendants may, if they can, show

reason why your orator should not have the relief hereby prayed, and that they may make a full disclosure and discovery of all the matters aforesaid, and, upon their corporal oath and according to the best and utmost of their knowledge, remembrance, information, and belief, full, true, direct, and perfect answer make to the matters and things hereinbefore stated and charged, and particularly to such of the several interrogatories hereinafter numbered and set forth as by the note hereunder written they are required to answer—that is to say:

1. Whether the said original letters patent No. 70479, hereinbefore mentioned, were granted and issued to F. W. Lurmann on the 5th day of November, 1869, as aforesaid.

2. Whether the said original letters patent No. 70447 were reissued to the said George Asmus on the 24th day of November, 1868, as aforesaid.

3. Whether the said defendants or either and which of them have at any time and when and during what period of time made, used, or sold any and how many blast furnaces constructed in whole or in part upon the principles and in the manner described in said re-
issued letters patent No. 3204, granted to George Asmus on
152 November 24, 1868, as aforesaid. Describe minutely and in
detail their construction and operation.

And that the said defendants may answer the premises, and that they may be decreed to account for and pay over the income or profits thus unlawfully derived or which might have been derived from the violation of the rights of your orator as aforesaid, your orator prays that your honors, upon entering of the decree in favor of your orator against said defendants for infringement as above prayed for, may also proceed to assess or cause to be assessed under your directions as well the profits or income to be derived therefrom, to be accounted for as aforesaid, as also in addition thereto the damages sustained by your orator by reason of such infringements, and that your honors may increase the actual damages so assessed to a sum equal to three times the amount of such assessment under the circumstances of the wilful and unjust infringement committed by said defendants as hereinbefore set forth; and, further, that the said defendants may be restrained from any further violation of the rights of your orator as aforesaid, your orator prays that your honors may grant a writ of injunction, issuing from and under the seal of this honorable court or issued by one of your honors, perpetually enjoining and restraining the said defendants, their clerks, attorneys, servants, agents, and workmen, from any further construction and sale or use in any manner of said patented improvements or any part thereof in violation of the rights of your orator as aforesaid, and that the blast furnaces containing said improvement now in possession or use of the said defendants may be destroyed or delivered up to your orator for that purpose; and your orator further prays that a provisional or preliminary injunction be issued restraining the said defendants from any further infringement of said recited letters patent pending this cause; and

they pray for such other relief as the equity of the case may require and to your honors may seem meet.

153 May it please your honors to grant unto your orator not only a writ of injunction, conformable to the prayer of this bill, but also a writ of subpœna of the United States of America directed to the said Dunbar Furnace Company, Charles Parrish, and A. B. De Saulles, commanding them, on a day certain therein to be named, to appear and answer unto this bill of complaint and to abide and perform such order and decree in the premises as to the court shall seem meet and may be required by the principles of equity and good conscience.

BAKEWELL & KERR,
Solicitors for Complainants and of Counsel.

NOTE.—The defendants are required to answer each of the foregoing interrogatories numbered one to three, inclusive.

BAKEWELL & KERR,
Solicitors for Complainants.

UNITED STATES OF AMERICA,
Western District of Pennsylvania, } *ss:*

Before me, the subscriber, duly authorized to administer oaths, personally came George Asmus, the complainant in the foregoing bill named, who, being duly sworn, deposes and says that so far as the statements herein contained are within his own knowledge they are true and so far as they are derived from the information of others he verily believes them to be true; and he further says that he verily believes the said F. W. Lurmann, in said bill named, to be the original, true, and first inventor of the new and useful improvement in blast furnaces which is described in the reissued letters patent granted to the said complainant and mentioned in the foregoing bill; and, further, that the said deponent verily believes that the title of the said complainant is as set forth in said bill.

GEORGE ASMUS.

154 Sworn to and subscribed before me this 16th day of October, A. D. 1877.

[SEAL.] BENJAMIN WRIGHT,
Notary Public, N. Y. Co.

Indorsed: No. 215. Nov. term, 1877. George Asmus *vs.* The Dunbar Furnace Company *et al.* Bill of complaint. To H. D. Gamble, clerk. Issue subpœna, returnable to the first Monday of December next. Bakewell & Kerr, solicitors for complainant. Filed Oct. 17, 1877.

Subpœna.

UNITED STATES OF AMERICA,
Western District of Pennsylvania.

The United States of America to the Dunbar Furnace Company; Charles Parrish, president, and A. B. De Saulles, vice-president, Greeting:

We command you and every of you that you appear before our judges of our circuit court of the United States of America for the western district of Pennsylvania, at the city of Pittsburgh, in said district, on the first Monday of December next, to answer the bill of complaint of George Asmus for infringement of letters patent, this day filed in the clerk's office of said court in the city of Pittsburgh, then and there to receive and abide by such judgment and decree as shall then or thereafter be made, upon pain of judgment being pronounced against you by default; and this you are in nowise to omit under such penalties as are inflicted by the laws of the United States.

Witness the Honorable Morrison R. Waite, Chief Justice of the Supreme Court of the United States of America, at the city of Pittsburgh aforesaid, this 17th day of October, in the year of our Lord one thousand eight hundred and seventy-seven, and of our Independence the 102d.

[SEAL.] H. D. GAMBLE, *Clerk.*

155 MEMORANDUM.—The above-named defendants are required to enter an appearance in this suit, in the clerk's office of said court, on or before the day to which the above writ is returnable; otherwise the complaint will be taken against them as confessed and a decree entered accordingly.

H. D. GAMBLE, *Clerk.*

Indorsed: No. 215. Nov. term, 1877. Circuit court of the United States. George Asmus *vs.* The Dunbar Furnace Co. *et al.* Chancery subpœna. Returnable to first Monday in December, A. D. 1877. H. D. Gamble, clerk. Bakewell & Kerr, complainant's sol.

Served this writ October 22d, 1877, on A. B. De Saulles, vice-president of the Dunbar Furnace Company, at the office of the company, personally, by giving to him a true and attested copy of this writ and making known to him the contents thereof. N. E. I. as to Charles Parrish.

JOHN HALL, *U. S. M.*,
Per JOHN A. MESSMORE.

Sworn to and subscribed before me this 24th of October, 1877.

[SEAL.] J. M. OGLEVEE, *Pro.*

Answer.

In the Circuit Court of the United States for the Western District of Pennsylvania.

GEORGE ASMUS *vs.* DUNBAR FURNACE CO.; CHARLES PARRISH, President, and A. B. DE SAULLES, Vice-President.	No. 215. November Term, 1877. In Equity.

The answer of the Dunbar Furnace Company; Charles Parrish, president, and A. B. De Saulles, vice-president, to the bill of complaint of George Asmus.

These defendants, reserving all manner of exceptions, etc., for answer to the said bill, or to so much thereof as they are advised they are required to make answer thereunto, answering, say:

156 First. That the alleged improvement by the said F. W. Lurmann in blast furnaces, for which the said Lurmann obtained letters patent, mentioned in complainant's bill of complaint, was not a new improvement nor was he the inventor thereof, and said letters patent for said alleged invention or discovery improvidently and improperly issued to him. And these defendants, further answering, say that the said alleged improvement had for many years been in use and was well known to those engaged in the construction and operation of blast furnaces.

And these defendants, further answering, say that they have not used in the blast furnace of the said Dunbar Furnace Company the invention or improvement of the said Lurmann, but a device of one Maurice Healy, for which he holds letters patent.

And in answer to the several interrogatories annexed to the said bill of complaint the defendant answers as follows:

To the first and second they say that they have no knowledge or information, other than from the averments of the bill, as to the alleged grant of letters patent to F. W. Lurmann or the assignment to the plaintiff.

And to the third interrogatory they say that they have built and have now in operation one blast furnace in which they make use of a device similar in some respects to that described in the letters patent of the said Lurmann, but, as already stated, such device was not the original invention of said Lurmann, and they are advised that the cinder block in use at said furnace would not be an infringement of the letters patent of said Lurmann even if the same were not invalid and void because of want of novelty. Without this, &c. All which matters and things, &c.

DUNBAR FURNACE CO. [SEAL.]
A. B. DE SAULLES, *Vice-President.*

SAMUEL DICKSON,
By C. A. HAITE, *Of Counsel.*

Attest: CHARLES A. HAITE, *Clerk.*

157 A. B. De Saulles, being duly sworn, says that the facts stated in the foregoing answer, so far as they are stated of his own knowledge, are true, and so far as they are stated on the information of others he believes them to be true, and that the seal thereto affixed is the common or corporate seal of the said Dunbar Furnace Company, and has been so affixed in verification of its answer.

A. B. DE SAULLES.

Sworn and subscribed *coram* February 11, 1878.

H. D. GAMBLE,
U. S. Commissioner.

Indorsed: No. 215. November term, 1877. George Asmus *vs.* The Dunbar Furnace Company. Answer. Filed February 11, 1878.

Replication.

Circuit Court of the United States for the Western District of Pennsylvania.

GEORGE ASMUS
vs.
THE DUNBAR FURNACE COMPANY *et al.*
} No. —. Nov. T., 1877. In Equity.

Te replication of the complainant, George Asmus, to the answer of the defendants, The Dunbar Furnace Company and others.

This repliant, saving and reserving to himself all and all manner of advantage of exception to the manifold insufficiencies to the said answer, for replication thereunto says that he will aver and prove his said bill to be true, certain, and sufficient in the law to be answered unto, and that the said answer of the said defendant is uncertain, insufficient, and untrue; without this, that any other matter or thing whatever in the said answer contained material or effectual in the law to be replied unto, confessed and avoided,
158 traversed and denied, is true; all of which matters and things this repliant is now and will be ready to aver and prove as this honorable court shall direct; and humbly prays as in and by his said bill he has already prayed.

BAKEWELL & KERR,
Solicitors for Complainant.

Indorsed: No. 215. Nov'r term, 1877. George Asmus *vs.* The Dunbar Furnace Company *et al.* Replication. Filed Feb'y 15, 1878. Bakewell & Kerr, counsel for complainant.

Testimony.

United States Circuit Court, Western District of Pennsylvania.

GEORGE ASMUS
vs.
THE DUNBAR FURNACE CO. *et al.* } No. 215. Nov. Term, 1877. In Equity.

To George Shiras, Jr., attorney for defendants:

Please take notice that the testimony of witnesses and other evidence on part of the complainant in above case will be taken before R. H. Whittlesey, notary public, or other competent authority, at our office, 94 Diamond street, Pittsburgh, on the 19th day of February, 1878, beginning at 2 o'clock p. m. and continued from day to day until completed. You can attend and cross-examine witnesses.

BAKEWELL & KERR,
Solicitors for Complainant.

FEBRUARY 13, 1878.

Service accepted February 13, 1878.

GEORGE SHIRAS, JR.,
Defendants' Attorney.

159 United States Circuit Court, Western District of Pennsylvania.

GEORGE ASMUS
vs.
THE DUNBAR FURNACE COMPANY *et al.* }

PITTSBURGH, PA., *Feb'y* 19, 1878.

Testimony of witnesses and other evidence, taken in accordance with the annexed notice, on the part of complainant, before R. H. Whittlesey, notary public, at the office of Bakewell & Kerr, 94 Diamond street, Pittsburgh, Pennsylvania, beginning at 2 o'clock p. m.

Present: T. B. Kerr, Esq., counsel for complainants; also the complainant; also C. C. Dickey, Esq., of counsel for defendants.

GEORGE ASMUS, called on part of complainant, is examined as follows by T. B. KERR, Esq.:

Counsel for complainant puts in evidence a certified copy of reissued letters patent No. 3204, granted to George Asmus, assignee to F. W. Lurmann, on November 24, 1868, for an improvement in blast furnaces, the same being a reissue of original letters patent No. 70447, dated November 5, 1867, granted to F. W. Lurmann.

* * * * * * *

PITTSBURGH, PA., *Feb'y 25th*, 1878.

It being inconvenient for Mr. Shiras, counsel for defendant-, to

cross-examine Mr. Asmus at present, it is agreed by counsel for both parties that Mr. Asmus shall sign his testimony, Mr. Shiras to have the right to cross-examine Mr. Asmus at some future time when the defendants are taking testimony and Mr. Asmus is present.

R. H. WHITTLESEY, *Examiner.*

TUESDAY, *April 11th*, 1878.

George Asmus was produced for cross-examination. Mr. Shiras, counsel for defendants, being present, waived cross-examination.

R. H. WHITTLESEY, *Examiner.*

160 *Motion to Close Testimony and Order.*

In the United States Circuit Court, Western District of Pennsylvania.

GEORGE ASMUS
vs.
DUNBAR FURNACE CO. *et al.* } No. 215. November Term, 1877. In Equity.

To defendants or George Shiras, Esq., their attorney:

Please take notice that on Saturday, August 17th, 1878, we will make a motion before the judges of the said court to close the defendants' testimony in twenty days, and to set the above case down for hearing in November next.

BAKEWELL & KERR,
Complainant's Solicitors.

PITTSBURGH, *August 12th*, 1878.

Service accepted.

GEORGE SHIRAS, JR.,
Def'ts' Att'y.

And now, August 17, 1878, the above motion is granted, and the court order that the defendants close their testimony in twenty days from this date, and that the case be set for hearing at the November term of the court.

PER CURIAM.

Indorsed: No. 215. November term, 1877. George Asmus *vs.* Dunbar Furnace Co. *et al.* Filed August 17th, 1878. Motion for order to close testimony and order thereon.

Order for Decree.

In the Circuit Court of the United States for the Western District of Pennsylvania.

GEORGE ASMUS
vs.
THE DUNBAR FURNACE COMPANY *et al.* }

Let a decree be entered for the complainant for an injunction and account.

W. McK.

161 Indorsed: No. 215. Nov'r term, 1877. George Asmus *vs.* The Dunbar Furnace Company. Decree allowing an injunction and an account. Filed March 7, 1879.

Decree.

Circuit Court of the United States, Western District of Pennsylvania.

GEORGE ASMUS *vs.* DUNBAR FURNACE COMPANY; CHARLES PARRISH, President, and A. B. DE SAULLES, Vice-President.	No. 215. November Term, 1877. In Equity.

And now, to wit, March 11th, 1879, this cause came on to be heard at this term on final hearing, and thereupon, upon consideration thereof, it is ordered, adjudged, and decreed that the letters patent in said complainant's bill mentioned, to wit, letters patent reissue No. 3204, dated November 24, 1868, for an improvement in blast furnaces, issued to the said complainant, assignee of F. W. Lurmann, the same being a reissue of original letters patent No. 70447, granted to said F. W. Lurmann on November 5th, 1877, are in all respects a good and valid patent; that the said F. W. Lurmann was the first and original inventor of the improvement in said reissued letters patent described and claimed; that the said complainant is entitled to the exclusive right in and to said reissued letters patent and in and to the invention and improvement secured thereby; that the said defendants, by reason of the construction and use of blast furnaces as in the said complainant's bill set forth, have infringed the said reissued letters patent and have violated the exclusive rights of the said complainant thereunder, and that the said complainant do recover of them, the said defendants, all gains and profits by them made and the damages sustained by complainant by reason of such infringement, as well as the costs and charges in this

162 suit to be duly taxed, and that it be referred to H. D. Gamble, residing at Pittsburgh, in said district, as master, to ascertain the amount of such gains and profits and of the damages sustained by the said complainant by reason of such infringement.

And it is further ordered, adjudged, and decreed that the said complainant, on such accounting, shall have the right to cause an examination of the said defendants Charles Parrish and A. B. De Saulles, *ore tenus* or otherwise, and also the production of the books, vouchers, and documents of the said Dunbar Furnace Company, and that the said defendants Parrish and De Saulles attend for such purpose before said master from time to time as said master shall direct and shall produce such books, vouchers, and documents, if desired.

And, further, that a writ of injunction, according to the prayer of said bill, be issued from and under the seal of this court, perpetually restraining and enjoining the defendants, their agents, employees, servants, workmen, and all others acting by and under their authority, from any further infringement of the said reissued

letters patent No. 3204 and of the exclusive rights of said complainant thereunder.

PER CURIAM.

Indorsed: No. 215. Nov'r term, 1877. U. S. circuit court, western district of Pennsylvania. In equity. George Asmus *vs.* Dunbar Furnace Co. Decree. Filed March 11, 1879.

In the Circuit Court of the United States for the Western District of Pennsylvania.

GEORGE ASMUS *vs.* THE DUNBAR FURNACE COMPANY *et al.* } No. 215. Nov'r Term, 1877. In Equity.

WESTERN DISTRICT OF PENNSYLVANIA, *ss:*

I, H. D. Gamble, clerk of the circuit court of the United
163 States for the said district, do hereby certify that the annexed and foregoing pages contain a true copy of the record and proceedings in the above-entitled case, so full and entire as the same remains of record and on file in my office.

In testimony whereof I have hereunto signed my name and affixed the seal of the said court, at Pittsburgh, this 11th day of April, A. D. 1884.

[SEAL.] H. D. GAMBLE, *Clerk.*

WESTERN DISTRICT OF PENNSYLVANIA, *ss:*

I, Marcus W. Acheson, judge of the United States district court for said district, do hereby certify that H. D. Gamble, above named, was at the time of making the above certificate and is now clerk of the said court, and that the said certificate made by him is in due form of law.

M. W. ACHESON,
Dist. Judge Holding the U. S. Circuit Court.

Pittsburgh, April 11th, 1884.

"EXHIBIT MERLE PATENT."

(2–175.)

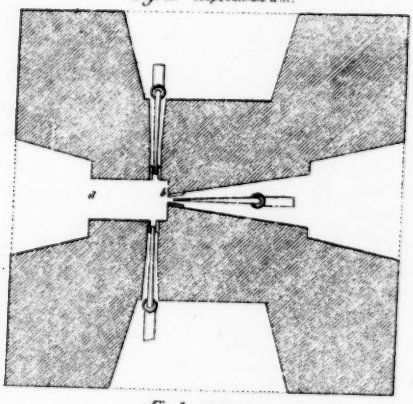
DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE.

To all persons to whom these presents shall come, Greeting:

This is to certify that the annexed is a translation, made by the official translator from the bound volumes of this office, of the specification of the French letters patent granted to Mr. Merle July 27, 1854, No. 20368, for improvements in blast furnaces.

In testimony whereof I, Benj. Butterworth, Commissioner of Pat-

Fig. 2. Coupe suivant a m.



No. 323.
Truman } p. 164.
N.
Asmus.

Fig. 1. Elévation.

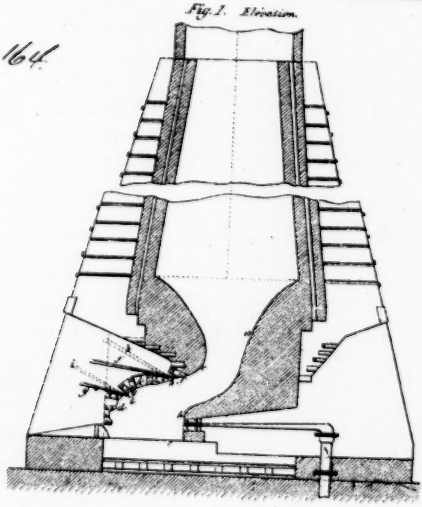
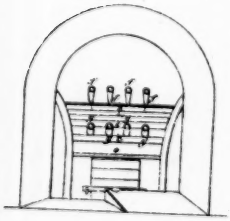


Fig. 3.



ents, have caused the seal of the Patent Office to be affixed
165 this 29th day of April, in the year of our Lord one thousand eight hundred and eighty-four, and of the Independence of the United States the one hundred and eighth.

[SEAL.] BENJ. BUTTERWORTH,
Commissioner.

French Patent.

2nd series, vol. 43, p. 172.

Publication No., 12333. Serial No., 20363.

27th July, 1854.

To Mr. Merle, of Paris, for improvements in blast furnaces.

Plate XXXV.

In order that the air blown in by the tuyeres may combine easily with the gases injected into blast furnace, the shape of the recess for receiving the air must be changed to that shown in Fig. 1 at *a b*, and the part above the tuyere must present the shape of an arch, *c d*.

(Here follows diagram marked p. 164.)

By this arrangement the gases and the air act more energetically on the materials that run along the inclined plane *a b*.

The part *c d* is made of bars of cast metal; only, to avoid the effect of too great heat, water is made to circulate over the plates.

The object of this change is to allow a space above the tuyere in which a current of air can be combined with the gases, and these gases, being very much heated in combining with the air, are thrown upon the materials to be melted, as the moment they descend the sloping wall of the furnace from *a* to *b* they can also be used by being directed to the lowest part of the furnace. It will be seen that by this arrangement the side tuyeres have to be moved from the centre of the furnace forward towards the front, as represented in the horizontal section, Fig. 2.

The arch *c d* is made of bars or plates of cast iron; but, as
166 the intense heat might melt them, matters are arranged in such manner that water can be made to circulate in some of them, as is usually done in drum tuyeres. The blast may be furnished by means ordinarily used; it may be hot or cold, but I prefer it hot, and brought in that condition to the front of the furnace by pipes in the ordinary way. The pipes conducting the blast must join the blast pipes shown at *f* and *q*.

In the arch *c d* are left openings sufficient to allow of raising and lowering these blast pipes to all desired angles, as, for instance, at *h* and *i*, and suitable mechanical arrangements are made for changing their position.

The drum and the slide-plate are as usual. The drum should be closed at the level of the slide-plates and should operate with closed furnaces; tuyeres are the same as those at present in use.

The blast pipes for the gas should be a little smaller than those of the tuyere, and, although there are eight of them represented in Fig. 3, the number can be increased or diminished if desired.

An opening, *k*, is left in the arch *c d* of oblong shape, with a lid to close it, for the purpose of introducing into the recess of the furnace any material suitable for the operation, In the blast furnace, as previously constructed, nothing could be added to the furnace except under the drum, which is usually filled with iron and slag or clinker, which prevent its being done easily; but it is often desirable to add materials of various kinds in the furnace—materials useful for melting the iron. I have provided such communication with the furnace by the opening *k*.

I also make openings in which the blast pipes are inserted large enough to allow the passage of bars or paddles used by founders when it is necessary to stir or push the materials in the various parts of the recess to place them in a suitable position. After the furnace has been heated throughout it is charged with charcoal, coal, wood, peat, carbonized or not, coke, anthracite, dry coal, iron ore, limestone, or other flux. When these charges have
167 been placed the blast begins at the lowest tuyere, and as soon as the furnace is in operation the iron descends freely in a liquid state in the furnace and the lower part fills up with molten metal, the dross running likewise through the slide-plate; then the blast can be admitted by the blast pipes into the arch *c d*. It meets the gases injected by the tuyeres and compels them, in the same manner as in the ordinary blast pipe, to strike the objects upon which the gas flame is directed, and the heat will extend all around through that part of the furnace.

When the iron is liquified the quantity of fuel can be gradually modified to economize it.

According to their construction the blast pipes are raised or lowered to blow at any desired part of the furnace; the space between the drum and the slide-plate should be closed in the ordinary manner, so as to prevent the loss of gas occasioned by the forward blast, and the clinker hole only is left open.

As the coal, the ore, and the flux sometimes descend very irregularly, and for that reason the furnace becomes cold, choked up, and, as we say, blocked, it is very desirable to have a remedy for the same. This result can be obtained by the opening marked *k*, seeing that anything lacking in the furnace can be added by that orifice.

"EXHIBIT KERL."

(2–175.)

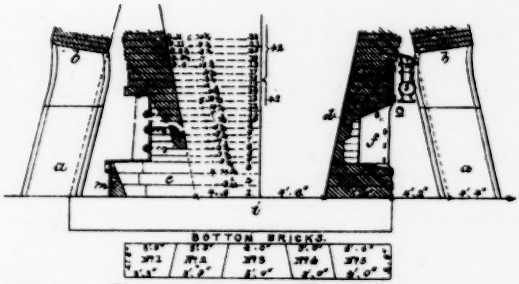
DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE.

To all persons to whom these presents shall come, Greeting:

This is to certify that the annexed is a true copy of a translation, made by the official translator from the bound volumes of

Blast-Furnace at Corngreaves.

No. 323.
Fretman
v.
Asmus.
} p. 170.



Lower portion of Fig. 29.

Figs 47.48.49.—Water-tymp.

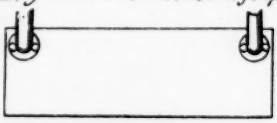


Fig. 47. Front Elevation.

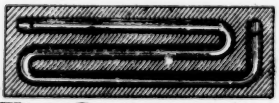


Fig. 48. Longitudinal section parallel to the large surface

Fig. 49.

Vertical transverse section.

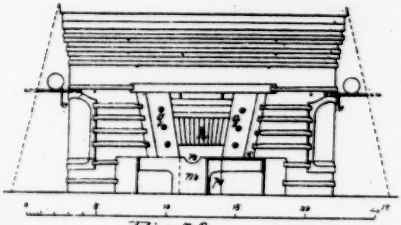
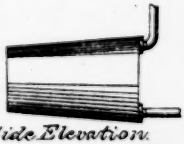
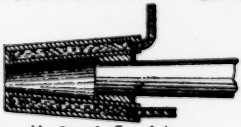


Fig. 32.
Front of Hearth.



Side Elevation.

End Elevation.



Longitudinal Section.

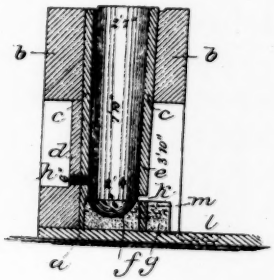
Fig. 44. Blast-furnace, Russells Hall

Kerl's Metallurgy,

Page 158 - Vol. 1.

Sächsischer Zinnofen

Fig. 33.



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} p. 168.

169 this office, of the text on page 158, volume 1, of Kerl's Metallurgy, and tracing of figure 33, sheet 2, in the matter of the same, "Saxon Tin-Smelting Furnace, published at Freiburg, 1855."

In testimony whereof I, Benj. Butterworth, Commissioner of Patents, have caused the seal of the Patent Office to be affixed this 24th day of June, in the year of our Lord one thousand eight hundred and eighty-four, and of the Independence of the United States the one hundred and eighth.

[SEAL.] BENJ. BUTTERWORTH,
Commissioner.

KERL, HUTTENKUNDE.

I, 158.

1. Saxon tin-smelting furnace (crucible furnace with open eye, plate II, Fig. 32): *a*, foundation; *b*, rough masonry; *c*, lining; *d*, partition wall; *e*, front wall; *f*, retort; *g*, brasque (clay and charcoal dust) floor; *h*, twyer; *o*, twyer arch; *k*, eye; *l*, tapping crucible; *m*, tap.

(Here follows diagram marked p. 168.)

"EXHIBIT PERCY."

(2–175.)

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE.

To all persons to whom these presents shall come, Greeting:

This is to certify that the annexed is a true copy from the bound volumes of this office of the description of hearth for blast furnaces and tracing of figures 32, 44, 47, 48, 49, and lower portion of figure 29, in the matter of the same, from Percy's Metallurgy, Iron and Steel, London, 1864.

In testimony whereof I, Benj. Butterworth, Commissioner of Patents, have caused the seal of the Patent Office to be affixed
171 this 12th day of May, in the year of our Lord one thousand eight hundred and eighty-four, and of the Independence of the United States the one hundred and eighth.

[SEAL.] BENJ. BUTTERWORTH,
Commissioner.

Percy's Metallurgy. Iron and Steel.

London, 1864.

Hearth, pp. 354–356.

The sides of the opening at the fore part are vertical to a certain height from the bottom and then slope outwards. At the top it is covered in by an arch termed the tymp arch, Figs. 29, 32, *k*.

(Here follows diagram marked p. 170.)

Immediately under this arch is fixed the tymp itself, which is a long rectangular casting of iron, containing in its interior a wrought-iron tube, through which cold water is kept circulating. See Figs. 47, 48, 49′. In making such a tymp the molten cast iron is poured into a sand mould, in which the wrought-iron tube is adjusted like a core. The tymp is secured firmly in its place by wrought-iron wedges. In front the hearth is prolonged outwards, as shown in Figs. 29, 35, *e;* it is closed in this direction by a wall or fire-brick called the dam, Fig. 29, *l*, of which the inner surface inclines outwards, while the outer one is vertical.

This engraving of a water tymp belongs to the furnace next in order of description and firmly supported by a strong cast-iron plate called the dam-plate, Figs. 29, 32, *m*. At the upper edge of this plate is a notch, *n*, called the cinder notch, over which the stream of molten slag flows down the inclined plane leading therefrom, called the cinder fall. See Fig. 33. At the bottom of
172 the dam and, in the furnace now being described, on the right hand of the dam-plate is a channel, the tapping hole, communicating with the interior of the hearth, and through which the metal is tapped out, Figs. 32, 35, *p*. During the working of the furnace it is stopped by ramming in sand. In some furnaces a notch in the bottom of the dam-plate itself forms the mouth of the tapping hole. But this arrangement is strongly objected to by some furnace managers, because if the furnace "works cold" or is stopped from any accident it would be necessary to cut the tapping hole upwards, which could not be done under the circumstances. The space between the top of the dam and the tymp is stopped either with sand or clay more or less completely, care being subsequently taken to form a channel for the escape of the slag when it has accumulated in the hearth to a sufficient height to overflow. On each side of the opening at the fore part strong plates of cast iron are fixed, Fig. 32, *q q*. The lower part of the hearth within the pillars is well braced with bars of iron dovetailed into the large castings which form the twyer openings, Fig. 32.

Twyer, p. 357.

This is a hollow truncated cone of wrought iron, of which the sides are hollow to allow of the circulation of cold water through them, as shown in Fig. 44. In the axis lies the nose of the blast pipe, which is also of wrought iron. When a twyer leaks, from being burnt or otherwise, it can easily be repaired. Twyers are usually made sufficiently long to allow of such reparation several times without being rendered too short to be unserviceable. They are placed with their axes horizontal and towards the centre of the furnace in a greater or less degree, according to circumstances. The open space of the twyer holes surrounding them is stopped with tempered shale or sand. Other kinds of twyer will be subsequently described.

A. D. 1863, June 12. N° 1470.
BEDSON'S Specification.

No. 323.
Freeman
v
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} p. 176.

FIG. 4.

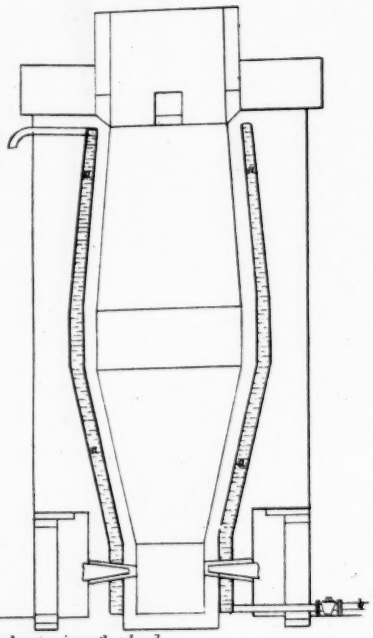
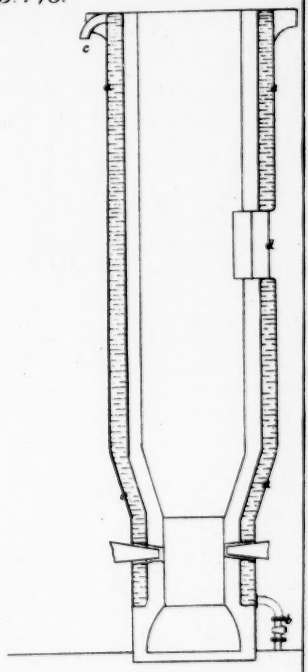


FIG. 3.



The filed drawing is partly colored.

FIG. 2.

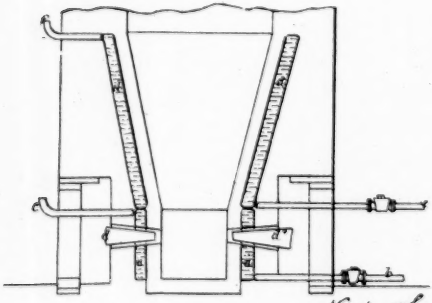
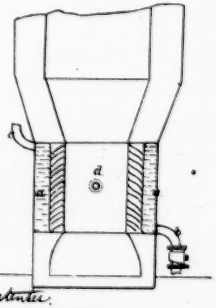


FIG. 1



Newton & Son
Agents for the patentee.

173 "EXHIBIT BEDSON."

A. D. 1863, 12th June. No. 1470.

Cupolas and Blast Furnaces.

Letters patent to George Bedson, of Manchester, in the county of Lancaster, for the invention of "improvements in cupolas and blast furnaces."

Sealed the 8th December, 1863, and dated the 12th June, 1863.

Specification in pursuance of the conditions of the letters patent filed by the said George Bedson in the Great Seal Patent Office on the 12th December, 1863.

To all to whom these presents shall come I, George Bedson, of Manchester, in the county of Lancaster, manager, send greeting:

Whereas her most excellent majesty Queen Victoria, by her letters patent bearing date the twelfth day of June, in the year of our Lord one thousand eight hundred and sixty-three, in the twenty-sixth year of her reign, did, for herself, her heirs, and successors, give and grant unto me, the said George Bedson, her special license that I, the said George Bedson, my executors, administrators, and assigns, or such others as I, the said George Bedson, my executors, administrators, and assigns, should at any time agree with and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend within the United Kingdom of Great Britain and Ireland, the Channel islands, and Isle of Man an invention for "improvements in cupolas and blast furnaces" upon the condition, amongst others, that I, the said George Bedson, by an instrument in writing under my hand and seal, should
174 particularly describe and ascertain the nature of the said invention and in what manner the same was to be performed and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said letters patent:

Now, know ye that I, the said George Bedson, do hereby declare the nature of my said invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement and accompanying drawings (that is to say):

"My invention consists, *finally*, in making those parts of cupolas and blast furnaces which are usually called the 'boshings' or 'hearths' of wrought-iron chambers and in supplying a stream of water to such chambers; and, secondly, I apply the same description of water chamber in other parts of cupolas or blast furnaces."

In the accompanying drawing—

(Here follows diagram marked p. 176.)

Fig. 1 represents the lower part of a cupola in section. At *a* is a water chamber entirely surrounding the "boshings" or "hearth." This chamber is constantly supplied with water by means of a pipe, *b*, provided with a stop-cock, by which the stream may be regulated at pleasure. The water passes through the chamber *a* and makes its exit at *c*, extending upward, so as always to keep a head of water, and thus the bossings or hearth are continually kept from being overheated, the stop-tap on the pipe *b* affording the means of regulating the temperature thereof. The water chamber *a* is shewn as embedded in masonry and as provided on its inward surface with shelves *e*, set at an angle and filled with clay or other such material used for protecting surfaces of iron from great heat. This clay or other such material fuses when the cupola is used and runs into a solid mass. This method of coating, however, is not absolutely necessary, for the water chamber may be lined with ordinary firebrick if desired. At *d* is one of the twyer holes, apertures being made through the chamber *a* for the required number.

175 Fig. 2 represents the lower part of a blast furnace in section. At *a* is a water chamber similar to that above described, fed with a stream of water at *b*, which flows out at *c*. The twyer holes are at *d**, there being, as before, apertures formed through the water chamber to admit them. Above the chamber *a* is another distinct water chamber, *d*, fed by a pipe, *e*, and provided with an outlet pipe at *f*. These chambers are represented as set in masonry both on the inward and outward surfaces, but may be used without masonry on the outside. The above examples shew the application of my invention to the lower parts only of cupolas and blast furnaces, but the whole length or any other portion thereof may be constructed after the same manner.

Fig. 3 represents a cupola in section, with a water chamber, *a*, extending from the hearth to the top, the supply pipe being at *b* and the exit pipe at *c*. At *d* an aperture is formed through the water chamber, constituting the usual feed-hole.

Fig. 4 represents a blast furnace in section provided with a water chamber, *a*, extending throughout the length of the furnace, the supply pipe being at *b* and the exit pipe at *c*. In the two last described figures the water chamber is shewn as constructed in one part only, but it may be in two or more portions, each one provided with a separate flow and exit pipe.

In applying my improvements above described an economy may be effected by using the water chambers for the purpose of obtaining steam.

Having thus described and ascertained the nature of my said invention and the manner of carrying the same into effect, I desire it to be understood that I claim as secured to me under the above in part recited letters patent the application of water chambers to the "boshings" or "hearths" or other portions of cupolas or blast furnaces which are exposed to heat.

In witness whereof I, the said George Bedson, have here-
177 unto set my hand and seal this eleventh day of December, in the year of our Lord one thousand eight hundred and sixty-three. GEORGE BEDSON. [L. S.]

"Exhibit Dalton."

A. D. 1855. No. 1000.

Furnaces.

Letters patent to Daniel Dalton, of Chester, ironmaster, for the invention of "improvements in furnaces for the smelting iron ore and iron stone and other stones and ores."

Sealed the 3rd November, 1855, and dated the 4th May, 1855.

Specification in pursuance of the conditions of the letters patent filed by the said Daniel Dalton in the Great Seal Patent Office on the 3rd November, 1855.

To all to whom these presents shall come I, Daniel Dalton, of Chester, ironmaster, send greeting:

Whereas her most excellent majesty Queen Victoria, by her letters patent bearing date the fourth day of May, in the year of our Lord one thousand eight hundred and fifty-five, in the eighteenth year of her reign, did, for herself, her heirs, and successors, give and grant unto me, the said Daniel Dalton, her special license that I, the said Daniel Dalton, my executors, administrators, and assigns, or such others as I, the said Daniel Dalton, my executors, administrators, and assigns, should at any time agree with and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend within the United Kingdom of Great Britain and Ireland, the Channel islands, and Isle of Man an invention for "improve-
178 ments in furnaces for the smelting iron ore and iron stone and other stones and ores" upon the condition (amongst others) that I, the said Daniel Dalton, by an instrument in writing under my hand and seal, should particularly describe and ascertain the nature of the said invention and in what manner the same was to be performed and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said letters patent:

Now, know ye that I, the said Daniel Dalton, do hereby declare the nature of the said invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement thereof (that is to say):

This invention has for its object a peculiar construction of furnace for smelting iron ore and iron stone and other stones and ores. For this purpose the chamber of the furnace is to be built with a feed mouth at top similar to a blast furnace. At the lower part this chamber is formed hollow, to receive the metal as it descends, and from which it is to be tapped. This furnace has at one or more sides a fireplace, the heat and products from which pass towards the chamber of the furnace in which the ore is placed. At the side of the furnace rises a flue, or the flue may surround or partially sur-

round the furnace. A damper is used to regulate the draft up such flue or the furnace may be constructed without the flue or flues, though I consider it best to have them.

And, in order that my said invention may be fully understood and readily carried into effect, I will proceed to describe the drawing hereunto annexed, which shows a longitudinal section of a furnace constructed according to my invention.

(Here follows diagram marked p. 180.)

A is a feed mouth or hopper, into which the ore and fuel is placed and from which it descends to the body of the furnace B, where it is exposed to the flame from the fire C; D is the chimney or
179 flue, which is here shewn passing up by the side of the feed mouth or hopper A, but it may be otherwise arranged; E and F are the two tap holes; the lower one, E, is to withdraw the metal from the furnace as it runs down, and the upper one, F, is for tapping off the slag.

Having thus described the nature of my invention and the manner of performing the same, I would have it understood that I do not confine myself to the exact details described; but what I claim is the peculiar construction of furnace for smelting iron ore and iron stone and other stones and ores hereinbefore described.

In witness whereof I, the said Daniel Dalton, have hereunto set my hand and seal this thirteenth day of October, in the year of our Lord one thousand eight hundred and fifty-five.

DANIEL DALTON. [L. S.]

Witness:
ALFRED DALTON, *Chester.*

181 UNITED STATES PATENT OFFICE.

ISAAC C. BRYANT, of Philadelphia, Pennsylvania.

Improvement in Furnaces for Manufacturing Iron.

Specification forming part of Letters Patent No. 1057, dated December 31, 1838.

To all whom it may concern:

Be it known that I, Isaac C. Bryant, of the district of Northern Liberties, in the county of Philadelphia and State of Pennsylvania, have invented a new and useful improvement in the furnace for the manufacture of iron from the ore, called the combined hot-air blast-furnace; and I do hereby declare that the following is a full and exact description.

My invention consists in the application of four new features, parts, or modes of construction of four several portions or parts of the furnance and its apparatus, with a view to improve and economise the manufacture of iron from the ore by anthracite or other coal, using the hot blast.

First. I improve the furnace by contracting its inner walls above

Bullens Patent 2nd Reg (1 Sheet)

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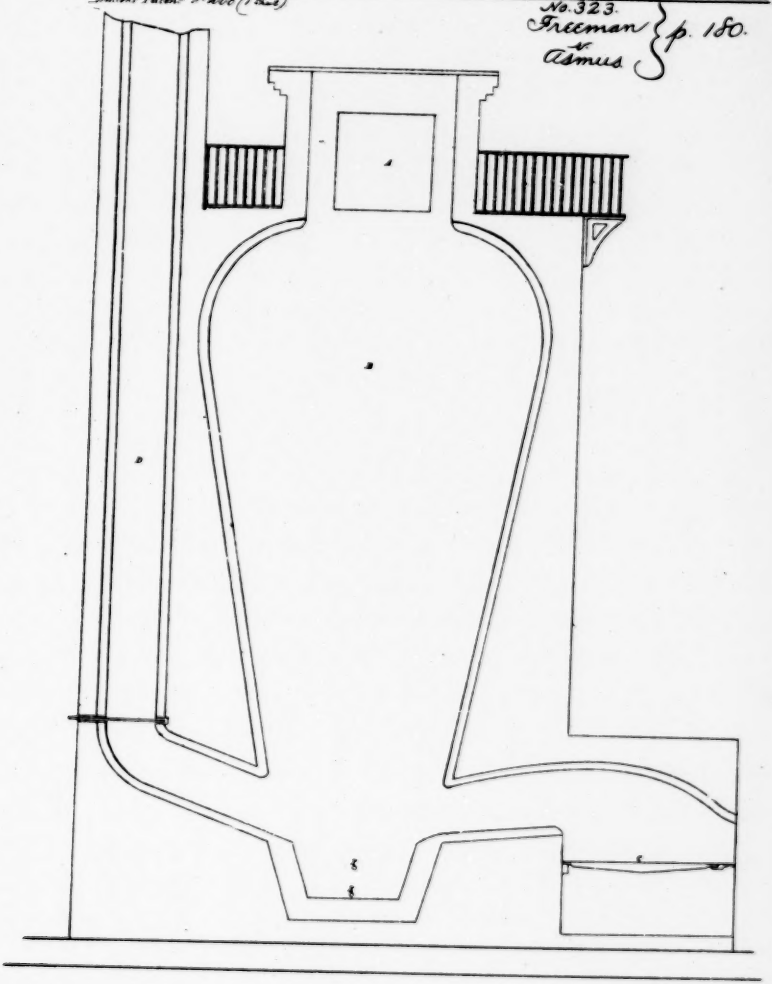


I. C. BRYANT.

Blast Furnace.

No. 1,057.

Patented Dec. 31, 1838

No. 323.
Freeman
v.
Asmus.
} p. 183.

Fig. 7.

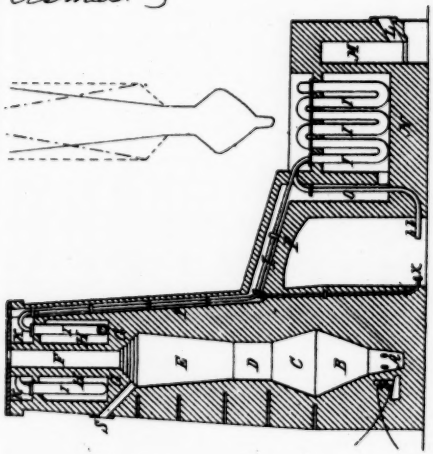
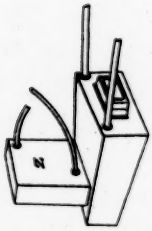


Fig. 2.

Fig. 5.



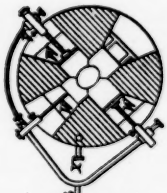


Fig. 1.

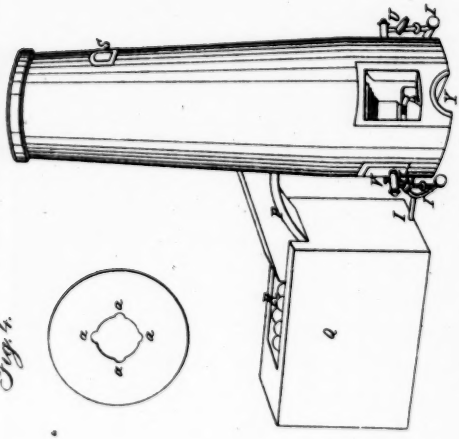
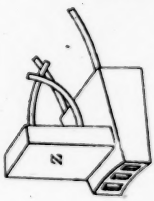


Fig. 3.

Fig. 4.

Fig. 6.



the customary bosh or spreading, B, Fig. 2, and making a second bosh or enlargement or the interior of the furnace, E, Fig. 2, above the first or customary bosh, B, and above the said contraction C, Fig. 2. A second or third contraction and a third or fourth bosh may be added, if found expedient, the object being to diminish the pressure of coal on the lower or customary bosh, and the liability to wedging or compression of the coal at the lower part of the furnace when anthracite is used.

Second. I improve the furnace by making recesses or grooves, Fig. 4, *a a a a*, on the inner surface of the furnace extending vertically upward from the crucible or from the tops of the tuyeres, or from the lower part of the furnace into or near the top of the first bosh or spreading, and farther, if deemed expedient, the object being to allow the ascent of air and heat through these grooves, and thus diminish the excess of heat at and near the crucible, and diffuse the heat and combustion more equally throughout the mass. The number of these grooves or recesses may vary as expediency may dictate.

Third. I improve the convenience and economy of the method of heating the air for a hot blast by contracting the uppper part of the furnace to a large flue, F, Fig. 2, and constructing a chamber, H H, surrounding it between an outer and an inner cylinder, the outer cylinder consisting of the exterior wall of the furnace, and the inner cylinder consisting of the exterior wall of the said flue F. In this chamber I heat the air for blast by passing through the chamber the blast-pipe in numerous undulations, convolutions, or windings, so as to expose a great surface to the heat of the chamber which escapes from the upper part of the furnace, and is conducted into the lower part of the chamber by several smaller flues or pipes passing from the furnace near the foot of the flue F underneath the brick-work G G.

Fourth. I improve the water-tuyeres or parts through which the blast enters the crucible of the furnace by making a narrow and oblong opening from each tuyere (see Fig. 6) for the passage of the blast, instead of a round opening, as usually practiced, thereby diffusing the application of the blast more extensively around the furnace and upon the fuel.

Fifth. I cool the crucible of the furnace and prevent its burning rapidly away by placing around it several metallic boxes or cases filled with water, the water entering at an aperture in the lower portion of each box and passing out at the upper portion, so as to keep up a constant current, and thus absorb a portion of the heat from the crucible.

These improvements are described in connection with the whole furnace and with reference to the annexed drawings, as follows:

(Here follows diagram marked p. 183.)

Figure 1 exhibits a front view of the entire furnace. Q, Fig. 1, the smaller furnace, which may be attached to the main furnace for the purpose of further heating the blast after it has first been heated

in the chamber H H, Fig. 2, before mentioned. R shows the upper curvatures of the pipe in which the air is heated. I I I, Fig. 1, are parts of the continuation of the same main pipe. U U are side valves for shutting off the blast from the furnace or for letting on such quantity as may be desired. V is one of three screws, more particularly described by reference to Fig. 3. S exhibits the feeding-door for admitting fuel, ore, and limestone, which may be also admitted at the top of the furnace through the large flue F, Fig. 2. Y is the arch forming the false bottom.

Fig. 2 exhibits a vertical section of the main and air-heating furnaces. A is the crucible. B is the first or customary bosh or spreading in diameter. C, D, and E are the contraction, continuation, and subsequent enlargement of the diameter of the interior surface of the furnace, which enlargement B constitutes the
182 second bosh, the said contraction and enlargement being a part of my improvement. F is the upper part of the interior of the furnace contracted to a large flue or cylinder to give space for the double cylindrical chamber H H, which surrounds the flue F. In this chamber H H the air for blast is first heated by being passed through it in the pipe or pipes with suitable convolutions to increase the surface exposed to the heat. This chamber and the arrangement for placing it constitute a portion of my improvement. Flues which cannot be seen in the drawings pass near G G from the furnace into the chamber H H for the purpose of heating it, and passing through it a portion or the whole of the escaping air of the furnace, which is thence conducted by suitable flues to the top of the furnance. S is the opening for fuel, &c., already described. G G is the projecting brick-work forming the bottom of the chamber, and J J is the projecting brick-work forming the top of the chamber and protecting the joints on the pipe from the action of the fire. K K are spaces left to afford access to the joints of the pipe. These spaces are usually filled with sand to prevent the escape of heat. L is the feeding-door of the extra furnace Q. M, Fig. 2, is the arch of the fire-grate bars, which bars are visible in Fig. 3. N is the stone or brick foundation, on which the convolutions of the pipe in the furnace Q rest. O and P are flues for the passage of the pipes and the escape of the air used to heat the extra furnace Q.

Fig. 3 exhibits a ground view or horizontal section of the main and air-heating furnaces taken at the level of the crucible. W W W are three tuyere blast-pipes leading from the main pipe I into the tuyere-arches, which arches are built in the customary manner. V V V are three screws fitted into enlargements of the tuyere-pipes for the purpose of slipping the tuyere-pipes out or retaining them in their po*po*sition, as may be wished. The blast of cold air from the atmosphere enters the blast-pipe's eye at X, Figs 2 and 3. It passes up to the heating-chamber H H; thence, after being heated, it passes down by the descent of the pipe and through the flue P into the extra or air-heating furnace, where it is further heated, the convolutions of pipe being seen at I I I in Figs. 2 and 3; thence it passes through the flue O and out of the heating-furnace at *b b*, Figs. 2 and

3; thence it passes into the main furnace, as seen in Fig. 3, through the tuyere-pipes W W W.

Fig. 4 is a horizontal section of the furnace taken at a higher point than Fig. 3. *a a a a* are the grooves or recesses for the passage of air and heat, as already described, constituting a portion of my improvement.

Figs. 5 and 6 are different views of one of the water-tuyeres, showing in Fig. 5 where the blast enters the tuyere and in Fig. 6 the opening whence it escapes to the furnace. Z, Fig. 5, and Z, Fig. 6, are two of the cases or boxes containing water placed over the tuyeres and around the crucible to cool the latter by a current of water passing through them and absorbing a portion of heat.

In Fig. 7 the plain lines show the form of the first and second boshes, as also represented in Fig. 2. The dotted lines of Fig. 7 show different forms in which the extra bosh may be varied. The interior as well as exterior of the furnace may be made either round, oval, or square.

What I claim as my improvement is—

1. The application of the contraction C and the second bosh, E, with one or more additional contractions and boshes, if deemed expedient.

2. The application of the recesses or grooves, Fig. 4, for the purposes mentioned.

3. The application of the air-heating chamber H H, surrounding the upper portion of the furnace, and the arrangement by which it is effected, the object being convenience and economy of fuel, the said chamber being constructed and arranged in the manner set forth.

4. The use of an elongated opening in each of the water-tuyeres, for the purpose already stated.

5. The use of boxes or cases containing water constantly shifted by a current placed around the crucible, so as to absorb a portion of its heat and increase its durability. These boxes may be made in number and breadth only equal to the water-tuyeres, or they may be increased either in number or in breadth, so as to form an entire circle around the crucible. Their size and thickness may be varied as experience may prove to be expedient. They may be extended in height from the bottom of the crucible to the top of the square of the crucible.

6. The combination of the above improvements or new modes of construction, or of any one or more of them, with a furnace built in the ordinary manner in other respects, or in such manner as may be chosen by the founder.

I. C. BRYANT.

Witnesses:
THOS. P. JONES.
CHS. M. KELLER.

184 UNITED STATES PATENT OFFICE.

JAMES F. STILEMAN and ZABINA ELLIS, of Philadelphia, Pa.

Improved Melting and Smelting Furnace.

Specification forming part of Letters Patent No. 38513, dated May 12, 1863.

To all whom it may concern :

Be it known that we, J. F. Stileman and Z. Ellis, both of Philadelphia, Pennsylvania, have invented an improvement in melting and smelting furnaces; and we do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

Our invention consists in applying to a foundry cupola or other furnace, substantially in the manner described hereinafter, a box of any suitable form, having an opening through which may be discharged the slag or scoria which flows into the box from the furnace, and another opening through which the molten metal, which also passes from the furnace into the box, may flow from the latter.

The object of our invention is to obviate the difficulties which arise from an accumulation of undue quantities of slag or scoria in melting and smelting furnaces, as explained hereinafter.

In order to enable others skilled in the art to make and apply our invention, we will now proceed to describe its construction and operation.

On reference to the accompanying drawings—

(Here follows diagram marked p. 186.)

which form a part of this specification, Figure 1 is a vertical section of an ordinary cupola or foundry furnace with our improvement; Fig. 2, a sectional plan on the line 1 2, Fig. 1; and Fig. 3, a vertical section on the line 3 4, Fig. 1.

Similar letters refer to similar parts throughout the several views.

A represents the brick-work body of an ordinary cupola or blast furnace such as is commonly used in foundries, this brick-work resting on a plate, B, which is secured to the pillars C, the latter resting on the foundation-plate D, and supporting the upper plate, B′, of the furnace. Into the lower end of the furnace is fitted the usual clay cylinder, E, beneath which, in the plate B, is an opening closed by a door or doors, E′, hinged to the said plate. At a suitable distance above the base of the furnace is an enlargement, F, and within the latter is an annular chamber, G, into which the blast is introduced from the tuyere at *a*, to be discharged through openings *b* into the furnace.

The above-mentioned parts are too similar to those of ordinary foundry furnaces or cupolas to need a more elaborate description.

In front of the furnace, and near the base of the same, is a box, I,

STILEMAN & ELLIS. 186

Cupola Furnace.

No. 38,513. Patented May 12. 1863.

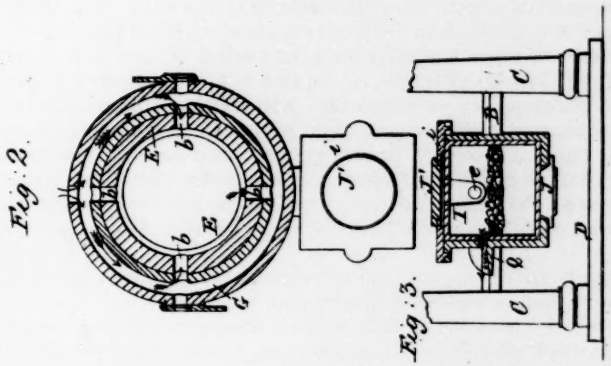


Fig. 2.

Fig. 3.

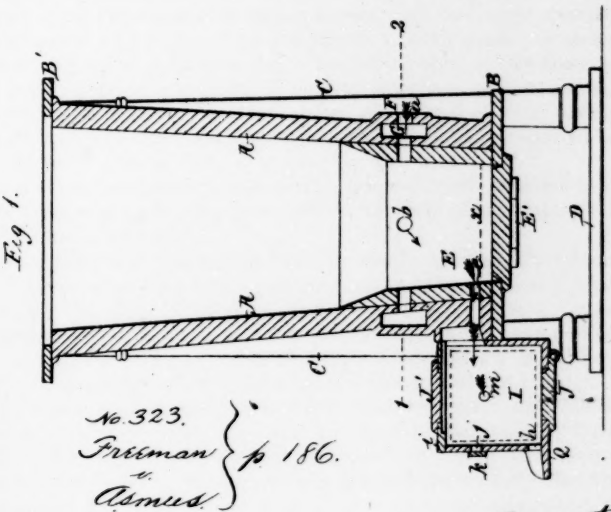


Fig. 1.

No. 323. Freeman v. Asmus } p. 186.

Witnesses

Inventors.

at the rear of which is an opening forming a continuation of the opening *e* in the furnace, the latter opening corresponding in position with what is known as the "tapping-hole" in an ordinary cupola. The box I, which is lined with fire-brick or fire-clay, extends some distance below this opening *e*, as best observed on reference to Fig. 1. It should be understood that the bottom of the furnace is represented by the line *x*, and that this line is on a level with the bottom of the opening *e*, the said line *x* representing the upper surface of a fire-brick or fire-clay lining resting on the door or doors E'. A cover, *i*, is secured to the box by bolts and nuts or other suitable fastenings, and in the bottom of the box is an opening closed by the hinged door J. In front of the box, and opposite the opening *e* of the furnace, is an orifice, *j*, having a slide or movable cover, *k*, for a purpose described hereinafter. In one side of the box, a short distance from the top of the same and at a point below the orifice *e*, is an opening, *m*, and in front of the box, near the bottom of the same, is a similar opening, *h*, a spout, Q, projecting from the box below each opening.

It is well known that great difficulty is experienced in melting, in ordinary foundry furnaces, scrap-iron which has been exposed for a length of time or which has been subjected to great heat. In melting old gas-retorts, for instance, so great is the difficulty that it is rarely attempted in ordinary foundry furnaces, these retorts being usually sold at a very low cost, to be forwarded to large smelting furnaces, where they are fused in conjunction with ores. The difficulty of melting old gas-retorts and other scrap-iron arises from the fact that an excessive quantity of slag or scoria is given out and accumulates so rapidly as to rise above the level of the tuyeres, causing a stoppage of the blast and interfering with the proper fusing of the metal, at the same time clogging up the fuel.

Our invention, the operation of which we will now proceed to describe, has been especially designed with the view of obviating the above-mentioned difficulty.

The fuel in the furnace having been properly ignited, the door J and cover J' of the box I securely closed, the opening *j* covered by the door or slide *k*, and the opening *h* temporarily plugged up with clay, and the blast introduced into the furnace, the old gas-retorts or other articles of scrap-iron are thrown into the furnace and gradually fused, both the metal and scoria or slag finding their way through the fuel to the bottom, and thence through the opening *e* into the box I. The molten metal being heavier than the slag, the latter will float on the top of the former, as represented in Fig. 3. When the box I has been so far filled that the slag reaches the opening *m*, it will flow through the same, the blast, which has constant admission to the box through the opening *e*, assisting to discharge the slag clear of the box, in which a constant supply of pure metal is thus maintained, to be drawn off as it is required through the opening *h*, after removing the clay plug from the latter. As both the molten metal and slag leave the furnace at once and find their way to the box I, it will be evident that no undue accumulation of slag can take place in the furnace, and

consequently that no obstruction of the blast and no inconvenient clogging of the fuel can take place, no matter what amount of slag may be given out in fusing the scrap-iron. Should the opening *e* be obstructed, the obstruction can be readily removed by passing a suitable instrument through the opening *j* into the said opening *e*.

Although we have described our invention as applied to an ordinary foundry furnace or cupola, it will be evident that it is equally well adapted to ordinary blast-furnaces for smelting ores, or to any furnaces in which an accumulation of slag or scoria is apt to collect to an inconvenient extent.

We are aware that it has been a common practice for many years to use boxes or reservoirs secured in a position adjacent to and so as to communicate with furnaces or cupolas for the purpose of collecting the molten metal prior to the same being used for casting. We therefore do not claim, broadly, such a device.

We claim as our invention and desire to secure by letters patent—

A box, I, of any convenient form, with its opening *m*, through which the slag is forced by the aid of the blast, and tapping-hole *h*, the whole being applied to a foundry cupola or other furnace, substantially as and for the purpose herein set forth.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

JAMES F. STILEMAN.
ZABINA ELLIS.

Witnesses:
A. H. SHOEMAKER.
JOHN McKEE.

(Here follow diagrams marked pp. 187, 188, 189, & 190.)

191 *On Furnace Hearths.**

By Geo. Asmus, New York city.

Closed front or open front for blast furnaces is, since a number of years, a much discussed question among the furnacemen in every country where iron is made. As blast furnaces are important institutions and as the whole question is one of economy, I hope to be excused if I enter a little into the details.

The "fore hearth" is a prolonged opening in the lowest part of the hearth, from two to three feet wide, four to six feet long, and from two to three feet high. It is a more or less fire-proof box, cooler than the inside of the hearth, and is apparently made for the purpose of letting the cinder out. Its front is closed by the "dam," over which the cinder runs and through which the iron cast takes place. As no iron is made in this part of the furnace, it being below the range of blast, and as it forms in most cases a source of daily work and sometimes the cause of most serious troubles, it is interesting to see why this thing was made at all. In olden

*Paper read before the American Institute of Mining Engineers, at the Cleveland meeting, October, 1875.

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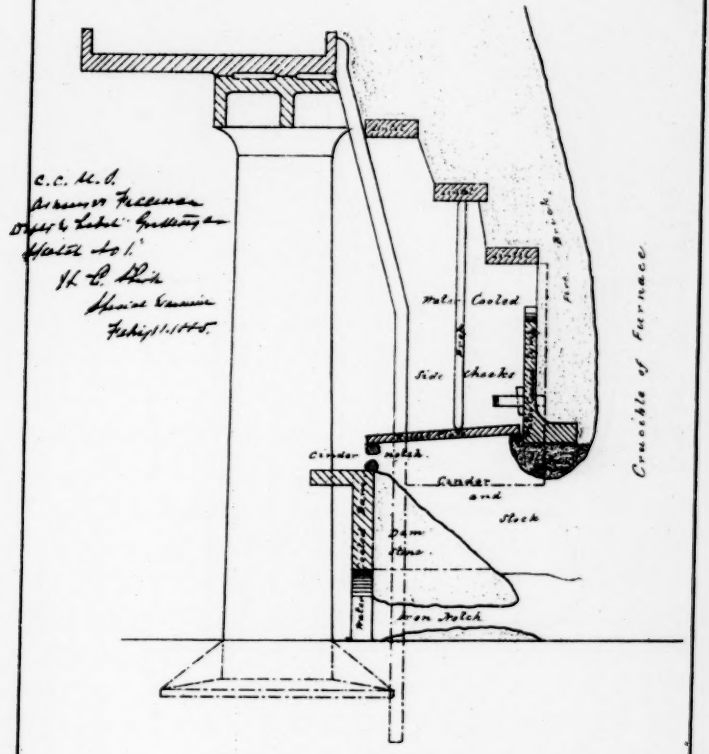
Dyes & Label Grinding & Mixing Mch.
H. C. Hunt
Shorthand Examiner
Feby 11 1885

No. 1.



C.C. U.S.
Asmus vs Freeman
Dyes & Label Grinding & Mixing Mch.
H. C. Hunt
Shorthand Examiner
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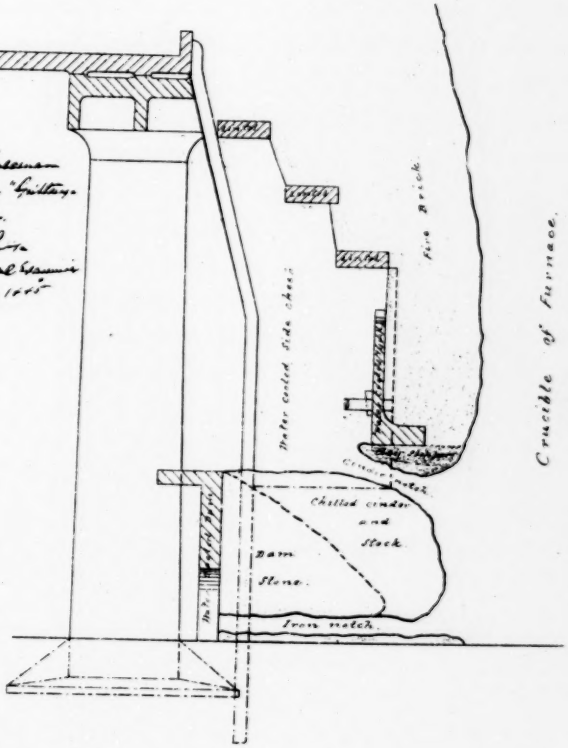
Asmus vs Freeman
No 2 Drft 4

C.C.U.S.
Asmus vs Freeman
Defts Exhibit "Gillette"
Sketch No 2.
H. L. Thorn
Special Examr
Feby 11 1885



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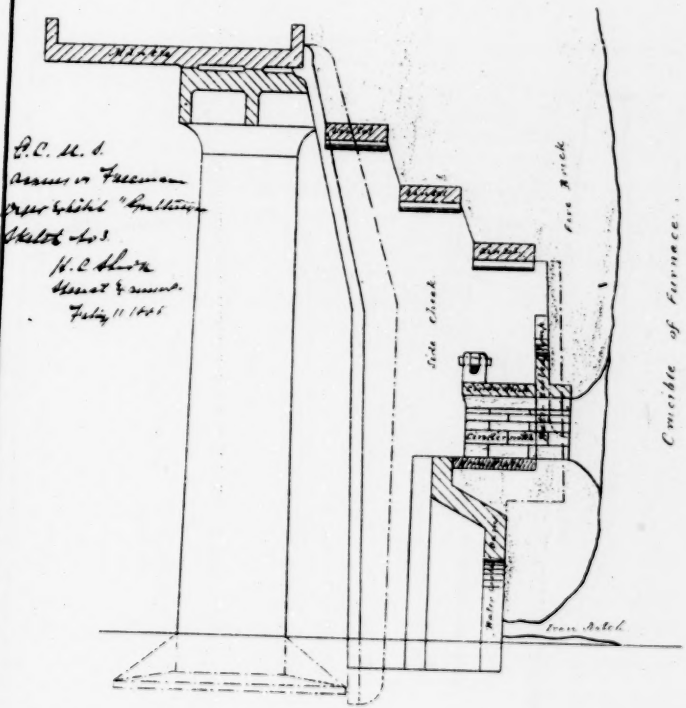
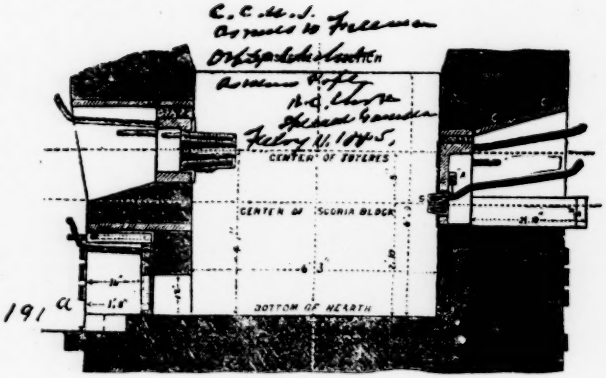
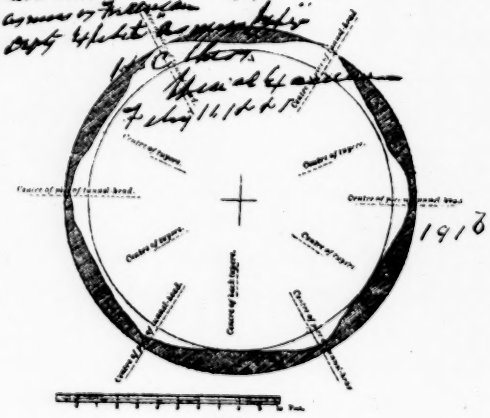
No. 3.





191 a



Back.

1918

times the furnaces had no fore hearth. A vertical slot a few inches wide was cut into the front hearth-stones, reaching to the bottom, and iron and cinder was tapped through the clay which closed it. Then furnaces were called Blauöfen—also Blaseöfen—blow-furnaces, and up to the present day some of those metallurgical relics have withstood the pressure of our fast times. They are in the remote mountains of Steyermark; charcoal furnaces, which make every day hardly a few tons of excellent iron. But a time came when men were no more satisfied with those little smelting pots, into which a gentle stream of air was blown through one nozzle, which received its scanty supply from a leather bag, squeezed by some tired water-wheel. Larger dimensions, more tuyeres, higher pressure, finer steam-engines, and hot blast produce more iron and more cinder. Soon the tapping slot in front got too hot; it was washed by the cutting fluids, and the natural move was to get farther off from the hearth. The slot became a prolonged outside bar, in which the cinder could rise, forming a communicating pipe with the hearth. But this part fills up, not only with fluid, iron, and cinder, but coal and half-smelted ore float into it, and, as the blast is intercepted, no combustion and no fusion can here take place. So this ore and coal become rubbish and often of a dangerous kind. Cast iron clings to it, and, after the tap is made, enough air blows upon it to effect a partial puddling, and there results a tenacious mixture of all kinds of steel and wrought iron, which paste the whole pile together. To prevent this the fore hearth has to be cleaned out, and that is what the smelters call working the furnace. A superstitious idea had come about that some incomprehensible but very bad matter lay hidden in all smelting material, which crept slyly into the fore hearth, where it was caught and kicked out. During this purifying process, of course, the blast had to be stopped, and the more industrious and faithful the smelter the more thoroughly he did his work and the longer the furnace stood still. So it was, up to eight years ago, everywhere and so is it still at a great many places. The loss of time by stopping the blast amounts from two to four hours out of every twenty-four.

The honor to have broken this practice is due to Fritz Lurmann, one of the most able blast-furnace engineers in Germany, and eight years ago I commenced, in connection with him, to bring his simple innovation—the closed front—before the ironmen of America. Lurmann's idea can be expressed with a few words: The fore hearth is only made to get rid of the cinder; it is a troublesome, additional construction, which has nothing to do with the smelting process proper at all; let us cut off this fore hearth completely and

(See diagrams marked 191*a* & 191*b*.)

tap the cinder through an opening just wide enough to suit the purpose, but which cannot burn out. It must be done by a water-cooled casting. This has to be a foot or so below the range of the tuyeres, and may be put in any part of the circumference of the hearth wherever it seems most convenient. The iron tap in front is

a separate matter; it may be water-cooled, as by the usual dam. Two great advantages are gained—cinder and iron are tapped directly from the hearth, and all the loss of time and all the labor in cleaning the hearth are saved. Quite a number of other advantages are gained; the tuyeres can be put absolutely equidistant, as no weak place has to be protected, and in consequence the smelting becomes perfectly even and the smelting column sinks vertically. As the heat is properly distributed the quality of the iron made in the different parts of the smelting one is uniform. The blast is always on, and as no slow combustion takes place in the furnace while an open hearth is open no coal is wasted. The air-heating furnaces are always kept in the same temperature because the blast is always on; no coal is wasted, and clay and tools, now quite an expense, are done away with. So we have a self-acting apparatus, which is actually in the hands of the manager.

The drawings show Lurmann's construction in detail when applied to new furnaces. When applied to old furnaces the minor details may differ, but the main points remain the same, and as the whole idea is correct its application to any furnace running on any material is unquestionable. If the furnace, as such, works, this arrangement does; and if the furnace does not work, no fore hearth can help it. Moreover, a large opening may be made in the furnace, if desired, without touching a brick simply by slipping out the cinder tuyere.

The facts have shown that Lurmann was right, and in Germany the open front has become obsolete. In England Lurmann's system has been only within a few years fully adopted and indorsed by many of the leading men, by Wm. Whitwell, for instance, and I am not able to understand the objection of Mr. I. Lowthian Bell that the cooling effect of the cinder outlet might be injurious to the furnace. Where, then, are half a dozen and more water-cooled tuyeres this little casting ought not to take all the blame.

In this country the opinions are much divided. A great many of these furnaces have run with perfect success for years in all parts of the country, and I am happy to say that the different furnaces you will see in Cleveland on your excursions are of this improved stamp.

As to the opposition, which seems to be strange, it is susceptible of explanation. First. I myself have made mistakes by taking the matter too easy and by making too many compromises with the old constructions I had to deal with; furnaces were altered while in blast; and, by doing this, part of the old fore hearth was left, which filled up and paralyzed the whole thing. In Mr. Pechin's case, spoken of last night, I was imprudent enough to raise the tuyeres about a foot while cutting off the throat of the furnace which was in blast.

Another reason why all furnaces do not bear the stamp of Mr. Lurmann's name as yet is to be found in the fact that most people would rather go step by step than jump at things at once. A great many, seeing that a fore hearth was not a necessity, have shortened it so much that little is left, gaining by doing this some of the advan-

tages the entirely closed front gives. Others close virtually and add some cleverly cooled casting somewhere near the cinder tap, which in some cases is done so nicely that only a very expert man is able to detect the difference. This I do not say to complain. My object here can only be to speak about the technical points, and the above remark was only made to show that Lurmann's sound plan has sent its roots much deeper than a superficial spectator might infer.

The increase of furnaces' product between the old system, as it was eight years ago, and the closed front in full has been found by careful comparison of a number of furnaces in Germany to be between 15 and 20 per cent.; the saving of fuel about 10 per cent.

Our objection, the burning of the iron cinder blocks, has been done away with by using hollow cast bronze blocks. These are almost indestructible, the cinder outlet remaining always of the original width of 1¼ inch, the cinder runs off quietly, and no hot air is blown out with it, though the blast is always on with full pressure.

Messrs. Taws & Hartman, at Philadelphia, have made, at my request, bronze cinder blocks and are now ready to cast tuyeres, either out of a proper bronze or of phosphor bronze made by the Pittsburgh Phosphor Bronze Co. This latter composition is the same as is used in England for tuyeres.

Toughness and rapid transmission of temperature are the two requisites wanted for a good tuyere.

The common bronze used in Germany is composed of 94 copper, 3 zinc, and 3 tin; in other words, as rich in copper as it can be made for casting purposes, because copper is, next to silver, the best conductor of heat among the metals. If we place the conducting power of silver for heat at 1,000 copper becomes 736 and iron 119.

Bronze tuyeres are actually cheaper than iron ones; they are more reliable, last longer, and can quickly be exchanged, because they keep bright even when stuck well into the furnace.

192 And afterwards, to wit, on the fifth day of May, in the year of our Lord one thousand eight hundred and eighty-six, come the parties aforesaid, by their counsel aforesaid; and this cause being called for argument on final hearing and having been argued by counsel for the respective parties, and the court, not being fully advised in the premises, takes further time to consider thereof.

And afterwards, to wit, on the fourteenth day of May, in the year of our Lord one thousand eight hundred and eighty-six, come the parties aforesaid, by their counsel aforesaid, and the court, being now fully advised in the premises, delivers the following opinion:

193 In the Circuit Court of the United States in and for the Eastern District of Pennsylvania, in the Third Circuit.

ASMUS *vs.* FREEMAN. } No. 8. April Sessions, 1884.

ASMUS *vs.* ALDEN. } No. 7. April Sessions, 1884.

BUTLER, *J.:*

These cases involve the same matter and have been heard together.

The suits are for infringement of letters patent No. 70447, dated Nov. 5, 1867, reissued Nov. 24, 1868 (No. 3024), to George Asmus, assignee of F. W. Lurmann. The infringement charged originally was of the first and several subsequent claims. At a later stage in the litigation the charge was limited to the first
194 and sixth. On the argument it was further limited to the first.

The answer denies the validity of the patent and the alleged infringement:

First. Is the patent (as respects this claim) valid?

Second. Has it been infringed?

Its validity is attacked on several grounds:

1. That the matter covered is not original with the patentee.

2. That it does not involve or show invention.

3. That it was not embraced in the patent as originally issued.

These objections will be considered in their order:

1. Is the matter claimed original? The state of the art prior to the patent shows that blast furnaces (the cylinders of which are not involved and need not be described) were constructed with a
195 "fore hearth," sometimes called a "tymp," being an outward projection at one side (commencing a few feet above and continuing to the foundation) into which, from the hearth proper (situated immediately behind at the bottom of the cylinder), there was an opening which allowed the molten iron and cinder to flow out. This projection was covered by a movable, horizontal, metallic "weight plate." The molten iron and cinder were thus drawn off from the bottom or hearth of the furnace into the "fore hearth," the cinder being lighter and floating on top. When the latter rose nearly to the level of the blast pipes or "tuyeres" it was removed through an opening just above the level of the fused iron. The act of removing it was called "tapping the cinder," and its performance was necessary several times in the intervals between drawing off the iron (through an opening
196 below). This operation of removing the cinder, known as "working the furnace," was a laborious and disagreeable performance. Mr. Grittinger describes it as follows: "The working of the furnace consisted in the removal of effete or dead matter that accumulates in the fore hearth by forcing the same upward with a

slight blast pressure and then shovelling it off. It was necessary at times to loosen the material by means of wringers and crust bars, which were inserted in the fore hearth. It frequently happened that the slag and effete matter chilled and could be removed only with difficulty. In such cases we were compelled to abandon the working of the furnace in the manner above described and remove
197 the slag through the opening marked cinder notch on sketch No. 2 until the fore hearth, by the operation of the furnace, became hot enough to undermine the crust, melt the effete matter, and make the crust removable. We frequently ran for weeks with the fore hearth in this chilled condition." Other serious difficulties were experienced in the use of the "fore hearth," among which was the chilling occasionally of the hearth, forming what is known as "salamander," stopping the operation of smelting and requiring the removal of some part of the walls of the furnace before the operation could be resumed. In this state of the art it occurred to Lurmann that these serious disadvantages might be avoided by dispensing entirely with the "fore hearth" (continuing
198 the wall of the furnace perpendicularly down to the foundation, thus closing the breast) and drawing off the cinder or slag by means of an aperture leading directly to the hearth, this aperture to be water-cooled so as to protect its walls, and that by employing a device called a "cinder notch," which may be fitted into the aperture, the flow of molten cinder might be regulated.

This conception, after being tested by experiment, was carried into practical operation and the patent in suit obtained.

While the claims are seven in number, the distinct elements or parts of the invention seem to be three:

a. The closed breast.

b. The water-cooled slag discharge leading directly from the hearth.

c. The device for regulating the flow of molten slag.

The principal in importance would seem to be the first,
199 which is made an element of the claim now involved. It might well have been made the entire subject of the claim. The patentee, however, has associated with it the water-cooled slag discharge and thus qualified and limited his right. That the matter covered by the claim was original with Lurmann is reasonably clear. Certainly there is no such evidence of anticipation as serves to repel the contrary presumption arising from the patent.

The defendants' evidence seems virtually to ignore that part of the claim which relates to the closed breast, attacking simply the water-cooled slag discharge, as separately claimed elsewhere. If this attack were sustained it would be immaterial to the result.

The combination of the slag discharge, even if old, with the
200 hearth of the closed-breast furnace would form a valid claim.

While, therefore, it is unnecessary to discuss the novelty of the slag discharge, described as an element in this claim, it is proper to say that I am not satisfied it is old. The record, in my judgment, fails to disclose anything calculated to cast doubt on the novelty of the combination described in the claim or of the first element

in this combination (the closed-breast furnace). Some reference was made on the argument to a cupola furnace, a different structure, intended for a different purpose, but the record contains no description even of this. How it resembles (if at all) the blast furnace here involved and why, therefore, it should be regarded as anticipatory, the court is not informed.

2. Did the patentee's improvement of the old furnace require invention? This question, I think, is free from doubt. What
201 constitutes invention in the legal sense is difficult of exact definition in terms. Where, however, an old device or machine in general use, with acknowledged serious defects which have been long endured because no one has previously discovered a means of obviating them, is taken in hand and by changing its form or structure they are removed and a different and greatly improved result obtained, it may safely be affirmed that the change required invention. Where the improvement and consequent public benefit is great, very little evidence of invention is required. Smith *vs.* Goodyear Co., 93 U. S., 48; Washburn *vs.* Manf. Co., 4 Fed. Rep., 907; Essinger *vs.* Richey, 14 Blatchf., 307; Isaacs *vs.* Abrams, 14 O. G., 862. The advantages arising from the plaintiff's improved furnace are very great, as the record shows—among them, that it
202 admits of a higher pressure of air, diminishes the labor attending the operation of smelting, increases the product while diminishing the cost, and lessening (if not avoiding) the danger of chilling. Indeed, so great are the advantages that it has virtually driven the old form of furnace out of use where the business of smelting is largely carried on.

3. Was the matter covered by the claim embraced in the original patent? The claim itself certainly was not. The matter claimed, however, as certainly was. The specifications originally filed say, among other things, "this invention relates to furnaces for smelting iron ore, and has for its object to dispense with the tymp or fore hearth" (tymp, we see, is used synonamously with fore hearth) "and the wall stone now in common use in iron blast furnaces, and
203 to replace the tymp arrangement by such a construction as allows the slag to be tapped directly from the hearth. * * * My furnace has no tymp" (that is, no fore hearth), "and the sides of the hearth, whether round or square, extend clear round to the bottom stone, the usual opening being made in the lower part of the hearth for the discharge of the iron." This language is as clear a description of the closed-breast furnace as could well be written. Calling it a closed-breast furnace would not be clearer. A furnace built in accordance with this language would necessarily be closed-breasted. The other element of the claim—"where the slag is discharged through an opening or openings cooled by water"—is no less clearly described. The drawings originally filed show the same. The claim might, therefore, have
204 been embraced in the patent as first issued or introduced into the reissue without changing the specifications. The change subsequently made simply expresses the same thing in different terms. The claim is not, therefore, an enlargement of the invention

as shown by the Patent Office or the patent. That such additional claim, omitted through "inadvertance, accident, or mistake," may be secured by means of a reissue, if applied for within reasonable time, is not open to question. Two years seems to have become the measure of reasonableness or limit of time within which ordinarily the application must be made. Here it was made a little after the expiration of one year. Whether the omission occurred through
"inadvertance, accident, or mistake" is (in cases proper for
205 amendment) a question for the Commissioner. The learned
counsel for defendants think Miller *vs.* The Brass Co., 104 U. S., 350, worked a change in this respect, prohibiting the introduction of new claims under all circumstances. This is a mistake. Such a result could only follow a repeal or disregard of the statute governing this subject. Miller *vs.* The Brass Co. simply applied the equitable doctrine of estop-el to a patentee who, after inexcusable delay (during which others may be presumed to have acted on the reasonable inference that all not claimed in the patent has been dedicated to the public), sought by means of a reissue to enlarge the scope of his patent so as to embrace and prohibit such acts. My
understanding of this case and its bearing on this subject was
206 fully expressed in The Combined Patent Can Co. *vs.* Lloyd,
11 Fed. Rep., 149. Subsequent cases have contained nothing different.

Second. Has the claim been infringed?

This question also must be decided against the defendants. Their furnaces are built with closed breasts, distinguishable in no material respect from the plaintiff's, and have water-cooled slag discharges leading directly from the hearth. It is no answer to say that these slag discharges are not water-cooled to the same extent as plaintiff's, nor that the defendants do not use the "cinder notch," which is made the subject of plaintiff's seventh claim and designed to regulate more completely the discharge of molten cinder. As
we have seen, the plaintiff's patent contemplates the use of
207 the slag discharge without as well as with this notch. If it
were true that the slag discharge embraced in the first claim contemplated the constant employment of the "cinder notch," the only difference between the defendants' discharge and the plaintiff's thus constructed would seem to be in the size and form of the opening and the degree of water-cooling, which would not be material.

Thus far we have not alluded to the suit brought in the western district of this State, founded on this patent, against the Dunbar Furnace Co. and others in 1877, which appears to have involved the questions now presented and in which a decree was entered for the plaintiff. While the decree was not final, it was under the circumstances entitled to little, if any, less weight on that account.
208 No opinion was filed, and the defendants here insisted upon
being heard as if the questions had not previously been considered. The plaintiff seeming in some measure to acquiesce in this, I have so heard them. Had I reached a different conclusion, however, I would not have acted upon it without a rehearing before the circuit judge who entered the decree referred to.

A decree will be entered for the plaintiff in pursuance of this opinion.

(Endorsed:) C. C. U. S., E. D. of Pa. Asmus *vs.* Freeman. No. 8. April sess., 1884. Asmus *vs.* Alden. No. 7. April sess., 1884. Opinion. Filed 14 May, 1886.

209 And afterwards, to wit, on the nineteenth day of July, in the year of our Lord one thousand eight hundred and eighty-six, the court enters the following decree, viz:

210 Circuit Court of the United States, Eastern District of Pennsylvania.

GEORGE ASMUS
vs.
MARGARET C. FREEMAN. } No. 8. April Sessions, 1884. In Equity.

And now, to wit, July 19, 1886, this cause came on to be heard at this term on final hearing, and thereupon, upon consideration thereof, it is ordered, adjudged, and decreed that the letters patent in said complainant's bill mentioned, to wit, letters patent reissue No. 3204, dated November 24, 1868, for an improvement in blast furnaces, issued to the said complainant, assignee of F. W. Luermann, is a good and valid patent; that the said F. W. Luermann was the first and original inventor of the improvement in said reissued letters patent described and claimed; that the said
211 complainant is entitled to the exclusive right in and to said letters patent and in and to the invention and improvement secured thereby; that the said defendant, by reason of the erection and use of a blast furnace, known as the North Cornwall furnace, near Lebanon, Pennsylvania, as in the said complainant's bill set forth, has infringed the first claim of the said reissued letters patent and has violated the exclusive rights of the said complainant thereunder, and that the said complainant do recover of her, the said defendant, all gains and profits by her made and the damage sustained by complainant by reason of such infringement, as well as the costs and charges of this suit to be duly taxed, and that it be referred to William C. Strawbridge, Esq., residing at Philadelphia, Pa., as master, to ascertain the amount of such gains and profits and
212 of the damages sustained by the said complainant by reason of such infringement.

(Endorsed:) No. 8. Apr. sess., 1884. Circuit court U. S., eastern dist. of Pa. Asmus *vs.* Freeman. Decree. Filed 19 July, 1886.

213 In the Circuit Court of the United States, Eastern District of Pennsylvania.

GEORGE ASMUS
versus
ANNIE C. ALDEN and MARGARET C. FREEMAN.

No. 7 and 8. April Sessions, 1884. In Equity.

Report of the Master. Filed December 10, 1887.

To the honorable the judges of the circuit court of the United States for the eastern district of Pennsylvania:

In pursuance of a decretal order in the above-entitled cause made on the 19th day of July, 1886, by which said cause was referred to the undersigned as master in chancery to ascertain and report to the court the amount of gains and profits which have accrued to the respondents by reason of the infringement by them of the exclusive rights of the complainant under reissued letters pat-
214 ent of the United States No. 3024, dated November 24th, 1868, to George Asmus, assignee of F. W. Lurmann, and the amount of the damages sustained by said complainant by reason of such infringement, the master respectfully reports as follows:

In pursuance of agreements made between counsel for the complainant and for the respondents herein, testimony and evidence was, between the second of December, 1886, and the 20th of April, 1887, and in the presence of the solicitors for the respective parties, taken and adduced in the cause, and said testimony and evidence and the arguments thereon of counsel for the respective parties were, upon the 22d day of September, 1887, submitted to the master.

These cases involve the same matter, were heard together by the court, and have been together submitted to the master. It is stipulated between counsel for the respective parties that three furnaces, hereinafter named, each fifteen feet in diameter across the boshes and each provided with the invention specified in claim 1 of the patent, were built and operated by the respondents during the following periods, namely, the so-called North Cornwall furnace, in the summer of 1878, the so-called Bird Coleman No. 1, in the fall of 1878, and the so-called Bird Coleman No. 2, built in 1880 and started in 1881, and that all of said furnaces continued in operation until the expiration of the complainant's patent here in suit.

The claims of complainant's patent are seven in number and are as follows:

1. "A blast furnace with a closed breast, where the slag is discharged through an opening or openings cooled by water, substantially as set forth.

2. "The slag-discharge piece or cinder block D, constructed and arranged, substantially as described.

215 3. "The cinder block D, in combination with the plate C, to which it is attached, substantially as described.

4. "The shape of the discharge opening or openings of the cinder

block D, being made flaring at its ends and of diminished diameter in the middle or central part, substantially as described.

5. "The combining of the slag-discharge piece or cinder block with a series of water channels or pipes, substantially as and for the purpose above set forth.

6. "Combining with the metallic plate C a series of water channels or pipes, substantially as and for the purpose set forth.

7. "The method of controlling the discharge of slag from blast furnaces by regulating the temperature of the slag-discharge piece or cinder block, substantially as described."

The court, in its opinion, says: "While the claims are seven in number, the distinct elements or parts of the invention seem to be three: (*a*) the closed breast; (*b*) the water-cooled slag discharge leading directly from the hearth; (*c*) the device for regulating the flow of molten slag."

But one of the seven claims of the patent, namely, the first, was held by the court to be infringed.

The complainant has offered evidence to establish a license fee; no evidence has been offered as to the profits made by the respondents or as to damages other than such as may be measured by a royalty. Complainant, by one of his witnesses, states his claim for royalty to be $1,000 upon each furnace on such furnaces as were supplied with the infringing device after January, 1880, and, on such furnaces as were supplied with the infringing device and used prior to that date, one hundred dollars a foot across the boshes upon each furnace.

In the argument before the master complainant's counsel
216 limited his demand for royalty to one thousand dollars upon each furnace for all respondents' furnaces, and his argument was directed to the establishment of the sum of one thousand dollars as the complainant's established license fee upon each furnace and as the proper measure of recovery in this case.

Respondents' counsel in argument has contended for two principal grounds of an award of nominal damages only, namely, first, that a full license fee cannot be exacted when but one of several claims of a patent is infringed and where no separate establised license fee for the infringed claim is shown; and, second, that no recovery of royalty can be had except in cases where the license fee is shown to have been uniform.

It is undoubtedly true that the general rule is that where less than the whole invention has been infringed evidence must be given to show the value of the part appropriated. Proctor *vs.* Brill, 4 Fed. Rep., 415; Wooster *vs.* Simonson, 16 Fed. Rep., 630.

This general rule fails where the claim infringed is shown to be the only one of the several claims of the patent which has or had any value or where it is shown that the different claims of the patent are for substantially the same invention. Westcott *vs.* Rude, 10 Fed. Rep., 830.

It also fails in cases where the claims of the patent other than the one or ones in regard to which the infringement has been decreed are merely for devices or instrumentalities in which the in-

vention specified in the claim or claims infringed may be embodied or by the aid of which it may be practiced—that is to say, in cases where the claims not infringed are structural only. Willimantic Thread Co. *vs.* Clark Thread Co., 27 Fed. Rep., 367; Cleon Tondeur *vs.* Stewart, Estep & Co., No. 14, November term, 1885, circuit court of the United States for western district of Pennsylvania (manuscript decision).

It was admitted before the master by counsel for the re-
217 spective parties that the use of the things specified in claims 2, 3, 4, 5, 6, and 7 of the patent in suit would at the same time necessitate the use of the invention specified in claim 1 and the consequent infringement of such claim. The master is of opinion that the things specified in claims 2 to 6, inclusive, of the Lurmann patent are but structural or specific forms of devices by the aid of which the invention of claim 1 of the patent may be constructed and worked; that therefore said claims are structural and are comprehended within the scope of claim 1, and that therefore said claims, under Willimantic Tread Co. *vs.* Clark Thread Co., *supra*, are not entitled to be credited with any part of a full-established license fee under the whole patent.

Claim 7 of the patent in suit is for a method of controlling the discharge of slag from a blast furnace by regulating the temperature of the slag-discharge piece or cinder block. No evidence has been offered by the parties as to the value of the invention specified in this claim or as to the existence of any separate established royalty or license fee therefor. It is admitted by counsel for the respective parties that the practice of the method of this claim could only be effected by the use of the invention specified in claim 1 of the patent and by the consequent infringement thereof. It is in evidence on the part of the complainant that a large number of licensees under the patent in the use of the invention of claim 1 do not employ the method specified in claim 7. There is no evidence in the case before the master of the use of the method of claim 7 by any one.

It was admitted by their counsel in argument before the master that the respondents did not regard the method of claim 7 as being of any practical value, and that had they so regarded it they would have adopted and practiced it.

The master deems it proper to report these facts, but, in conse-
218 quence of the view taken by him of the question of an established royalty or license fee, he does not deem it necessary to decide whether any part of an established license fee under the whole patent should or should not be attributed and credited to the method forming the subject of said claim 7.

The complainant, by the testimony of one of his witnesses, states that his license fee upon each furnace prior to January 1, 1874, was $150 per foot across the boshes; that from such date to January 1, 1880, it was $100 per foot across the boshes, and that on January 1, 1880, his license fee was reduced to $1,000 upon each furnace.

The complainant has offered testimony as to the grant by him and acceptance by licensees of sundry licenses under the patent in suit and of the payment by said licensees of license fees thereunder,

It appears that in some seventeen instances licenses were given by the complainant and accepted by the licensee upon the payment of a license fee or royalty of $1,000 *dollars* upon each furnace. In six instances where suit had been brought $1,000 upon each furnace was paid for a license by each licensee and accepted by the owner of the patent. For eight furnaces the sum of $666.67 for each furnace was paid to the owner of the patent by licensees. In another instance four furnaces were licensed for the lump sum of $3,500. In another instance four furnaces were licensed for the sum of $1,500. In another a suit under the patent against two furnaces was settled for the sum of $1,000, and in another one furnace was licensed for the sum of $100.

"A royalty to be binding on a stranger to the licenses which established it must be a uniform royalty." Walker on Patents, 390.

"No price can be said to be fixed or royalty established when the patentee varies his price according to the courage or the ability to resist of the infringer or where there are other circumstances showing the absence of a fixed established fee." Black *vs.* Munson, 2 Ban. & Ard., 626; Westcott *vs.* Rude, 19 Fed. Rep., 833.

219 In the present case it is in evidence that in some instances, where a less license fee than one thousand dollars was paid and accepted, the reduced fee upon each furnace was on account of a number of furnaces being licensed to the same licensee at the same time, while in other instances, in which reduced license fees were paid and accepted, suit had previously been brought and, upon the payment of a license fee, discontinued. In yet other instances, in which a less license fee than a thousand dollars was paid and received, no explanation is given for the reduction.

Under the cases cited the master is unable to find that the complainant has proved an established uniform license fee, and he is not of opinion that it is within the province of a master to find any one of a number of varying rates of license fees accepted by a complainant or to find any intermediate sum as a proper license fee.

Complainant has, under varying circumstances, accepted various license fees. In the opinion of the master any license fee found by him to be an established license fee must be one which has been uniform and one which the owner of the patent has established and received "in his dealings with others." Wescott *vs.* Rude, *supra.*

For the reasons stated the master finds that the complainant is entitled only to nominal damages of six cents.

WM. C. STRAWBRIDGE, *Master.*

Philadelphia, October 26, 1887.

(Endorsed:) C. C. U. S. Asmus *vs.* Freeman. No. 8. Apr. sess., 1884. Same *vs.* Alden. No. 7. Apr. sess., 1884. Master's report. Filed 10 Nov., 1887.

220 In the United States Circuit Court, Eastern District of Pennsylvania. In Equity.

GEORGE ASMUS
versus
ANNIE C. ALDEN *et al.* } No. 7. April Sessions, 1884.

GEORGE ASMUS
versus
MARGARET C. FREEMAN. } No. 8. April Sessions, 1884.

Proceedings in the Accounting.

Complainant's record.

W. Bakewell, for complainant.

221 In the Circuit Court of the United States in and for the Eastern District of Pennsylvania.

GEORGE ASMUS
versus
FREEMAN & ALDEN. } Before the Master.

Testimony of witnesses and other evidence taken before the master, W. C. Strawbridge, Esq., pursuant to agreement of counsel, at the office of Bakewell & Kerr, Pittsburgh, Pa., on December 2, 1886, on behalf of complainant.

Present: T. W. Bakewell, Esq., for Mr. W. Bakewell, on behalf of complainant, and W. D. Baldwin, Esq., for defendant.

THOMAS B. KERR, a witness produced on behalf of complainant, being duly sworn, deposes and says:

Int. 1. State your name, age, residence, and occupation.

Ans. Thomas B. Kerr; age, 37 years; residence, Allegheny City, Pa., and am an attorney-at-law.

Int. 2. State what you know, if anything, concerning the Luermann reissued patent in issue in this case and concerning the grant of licenses thereunder.

Ans. I am a member of the firm of Bakewell & Kerr. In
222 the summer of 1877 the complainant called at our office and retained us under the Luermann patent for the particular purpose of bringing suit against the Dunbar Furnace Co. This matter fell into my exclusive control, and I brought the suit, which was prosecuted, as appears by the records in this case, to a hearing and decree in favor of the complainant. The result of the matter was that I formed an intimate friendship with the complainant, which extended ever since, and that in the year 1882 he put the matter of granting licenses under the patent almost exclusively into my hands, so much so that even when he nogotiated for them he had the business of issuing the licenses transacted by me. In the settlement of the Dunbar case, which followed the decree for injunction

and account, I became familiar with his rates of license fees then in force. At that time he charged one hundred dollars a foot for every foot across the boshes or the widest part of the furnace. I also became acquainted with a previous rate of license fees which had been in force prior to January 1st, 1874, and which was one hundred and fifty dollars a foot. This was the rate at which the Dunbar Furnace Co. settled with the complainant after the decree in that case, the furnace having been built and put into operation prior to January 1st, 1874, which was the date of his reduction to one hundred dollars a foot. On January 1st, 1880, the complainant reduced his license fee to one thousand dollars a furnace, regardless of size. My personal experience in the granting of licenses was under this last-named schedule, and under it I issued licenses to the following concerns:

Oct.	11, 1883,	Bellaire nail works, 1 furnace	$1,000
"	18, "	Riverside works, 1 furnace	1,000
"	" "	Wheeling Iron Co., 1 furnace	1,000
"	" "	Benwood iron w'ks, 1 furnace	1,000
"	" "	Belmont Iron Co., 1 furnace	1,000
"	" "	Junction Iron Co., 1 furnace	1,000
Dec.	12, "	Eureka Iron Co., 2 furnaces	2,000
	Dec. 31, 1883,	Chattanooga I. w'ks, 2 furnaces	2,000
223	Feb. 12, 1884,	Powelton Furnace Co., 1 furnaces	1,000
	Mar. 4, "	Crozier Steel & I. Co., 1 furnace	1,000
Mar.	6, 1884,	A. M. Byers, 1 furnace	1,000
May	19, "	Albany & R. Iron Co., 1 furnace	1,000

In the winter of 1883–'4 the firm of Witherow & Gordon, furnace-builders at Pittsburgh, Pa., negotiated with me for the granting of a number of licences for furnaces which had been recently finished by them in the South and provided with the patented improvement. These furnaces were intentionally built with the improvement, but not in infringement, as their construction was known to the complainant and the patent was known and recognized by Witherow & Gordon, the question of license being merely deferred. Witherow & Gordon urged upon me that they were desirous of purchasing wholesale, and in view of the number were entitled to a good concession. Upon consultation with the complainant I offered to make a reduction of 33 per cent. in the price, and this was agreed upon, and they paid me the sum of four thousand dollars, which, however, was paid by the checks or drafts of the furnace companies. The following is the list covered by this payment:

Woodward Iron Co.,	1	furnace	$666 67
Sloss Furnace Co.,	2	"	1,333 34
Mary Pratt Iron Co.,	1	"	666 67
Alice Furnace Co.,	2	"	1,333 34

The Woodward furnace was finished in 1882; Sloss No. 1, in April, 1881; Sloss No. 2, in March, 1883; Alice No. 1 was finished in 1880. This furnace was not built by Witherow & Gordon, but was included in the reduction secured by them, they having built

Alice No. 2, which was completed in February, 1883. Mary Pratt furnace was completed in January, 1883. These furnaces were all blown in soon after their completion. The Crozier furnace, to which I have referred, was built by Witherow & Gordon and finished in March, 1883. The settlement was made on February 25, 1884.

224 The Roane Iron Co. of Chattanooga, Tenn., hearing about this settlement, immediately opened a correspondence with us, desiring to be admitted to the same terms and urging that they should not be put on different terms than their neighbors. Mr. Asmus, who had resided in this country since 1867, had at that time made arrangements to return to Germany to oversee the education of his children, one of whom was then there at school, and was very desirous to close up his business here. This and the considerations urged by the Roane Iron Co. led him to accept their proposition, and on March 16, 1884, I received from them the sum of $1,333.34 for licenses for two furnaces.

In addition to the above I made settlement with certain parties after filing bills against them. On January 10, 1882, Graff, Bennett & Co., of Pittsburgh, paid me $1,000 for license for the Clifton furnace, a small furnace at Pittsburgh. This settlement was made immediately after the filing of the bill. On August 3, 1882, I received $1,000 for a license for one furnace from Raney & Berger under similar circumstances. On November 24, 1883, I received $1,000 from Hogsett, Hanna & Co., of Fayette county, Pa., for a license for one furnace under similar circumstances.

On February 14, 1884, I received $1,200 from the Rockhill Iron Co. under the following circumstances: I had brought suit for infringement in two furnaces, but upon investigation I found, or it was shown me by their attorney, Mr. William Scott, of this city, that one of the furnaces had an open fore hearth and did not infringe, while the other was admitted to include the improvement, having been changed in or about 1882 from the old construction. Mr. Scott and I then settled the case for $1,200, the additional $200 being designed to cover costs and expenses incurred by the complainant in bringing suit, the defendant having had a full opportunity to settle the case before such steps had been taken. On May 15, 1884, I received $1,000 in settlement for one furnace from

225 the Cherry Valley Iron Co. of eastern Ohio. The bill in this case was filed at Cleveland, Ohio, and the decree *pro confesso* with reference to a master was taken. When we met to take the testimony before a master the defendant offered to settle for the infringing furnace, and I accepted the license fee and costs as usual. The license fee received was $1,000.

Suit was brought against the Cleveland Rolling Mill Co., a licensee, for the license fee for a furnace bought from another company and transferred to Cleveland, where it took the place of a dismantled licensed furnace. The transferred furnace had belonged to a company owning a license under the patent. The master found for the complainant and awarded $1,000 for that furnace, which was paid March 19, 1885. This case involved also the question whether a larger furnace which was erected in place of a dismantled licensed

furnace was a different furnace and not covered by the license. I mention this matter so that my first statement with regard to this suit having reference to the transferred furnace might not be misunderstood.

Adjourned to 2 o'clock p. m.

I find that I have no copy of the form of license used in granting the foregoing licenses. In every case that I can at present recall where I issued licenses without suit I made use of a printed form supplied by Mr. Asmus and signed by him, the latter to save the necessity of a power of attorney to myself. I will endeavor to procure one of these licenses and produce it as a part of my evidence in this case.

Int. 3. Where is the complainant in this case, Mr. Asmus?

Ans. He is at present in Europe; I think in Bonn. He has taken up his permanent residence in Germany. His testimony in this case could only be taken there, as his arrangements are such that he cannot return to this country at present.

226 Int. 4. How much does the complainant demand from the respondents in these cases?

Ans. One thousand dollars a furnace on such furnaces as were supplied with the infringing device after January 1st, 1880, and on such as were supplied with the infringing device and used it prior to that date one hundred dollars a foot across the boshes; I mean the diameter across the boshes. I now produce and put in evidence a copy of a circular from the complainant, dated January 1st, 1874, announcing the reduction of the royalty from one hundred and fifty dollars to one hundred dollars a foot. This circular I know to have been circulated to some extent by the complainant after my connection with him and before 1880. The copy I produce is somewhat mutilated, the lower end of the second page having been torn off by me some years ago for the purpose of getting a list of furnaces having the improvement, which was printed thereon. The missing part does not take away from the body of the circular. I have no other copy.

Cross-examination by Mr. BALDWIN:

X Int. 5. On page 89 of complainant's record Asmus gives a list of furnaces licensed under Luermann's patent. Please specify which of those you have personal knowledge of.

Ans. Charlotte Furnace Co., Scottdale, Pa.; Graff, Bennett & Co., Soho furnace, Shoenberger, Blair & Co., Laughlin & Co., Isabella furnaces, Edgar Thompson, Lucy, Dunbar, Low Moor, Eureka, Belmont, Riverside, Top Mill, Benwood, Chattanooga, Hogsett & Co., Bellaire, Wheeling, and Junction.

X Int. 6. When were the first six of these licenses you have mentioned, including the Isabella furnace, granted?

Ans. Charlotte, Nov. 6, 1883; Graff, Bennett & Co., Jan. 10, 1882; Soho, May 21, 1880; that is Moorhead, McCleane & Co.'s
227 furnace; Schoenberger, Blair & Co., one furnace in or about 1870; the second, I think, in 1881. I know the fact of the

first license to Shoenberger, Blair & Co. by reason of being their attorney and of the second for the same reason. I had personally nothing to do with these two licenses. Laughlin & Co.'s license, I think, was granted in 1868. It was the first use of the Luermann improvement in Pittsburgh. Isabella furnaces—I don't know when these licenses were granted, but my impression is that it was about 1879 or 1880. I had nothing to do with the granting of the licenses.

X Int. 7. Do you know what Laughlin & Co. paid for their license?

Ans. I understood from Mr. Asmus that they paid $1,000, and that that figure was a concession to them on account of the peculiar circumstances of their use, and the payment was made after the success of the improvement was demonstrated by practical experience. I have no other knowledge.

X Int. 8. Do you know what Shoenberger, Blair & Co. paid for their 1870 license?

Ans. No.

X Int. 9. What was the amount of the Isabella furnace licenses?

Ans. I don't know. I only know *that* the fact of the licenses by reason of being counsel for both parties in patent matters.

X Int. 10. When was the Dunbar license settled?

Ans. Dunbar Furnace Co. have two licenses—one granted very shortly after the decree in the suit, which was dated March 11, 1879, and which covered the furnace in controversy in that suit. The second license was granted since 1880. I cannot give the date without referring to some papers which I have not at present. My impression is that it was in 1881.

X Int. 11. What was the amount of the first Dunbar license?

228 Ans. I can't, without referring to some records, give you the total, but it was at the rate of $150 a foot. I don't recall the size of the furnace.

X Int. 12. What amount was paid for the second Dunbar license?

Ans. I don't know. It was issued by Mr. Asmus, and such part as I had in it only made me acquainted with the fact of the granting.

X Int. 13. Has not Mr. Asmus granted other licenses than those you have mentioned at less than $1,000 a furnace?

Ans. I have heard that he has.

THOMAS B. KERR.

SAMUEL E. MOORE, a witness produced on behalf of complainant, being duly sworn, deposes and says:

Int. 1. State your name, age, residence, and occupation.

Ans. Samuel E. Moore; age, 36 years; residence, Pittsburgh, Pa.; occupation, auditor for Carnegie Brothers & Co., Limited.

Int. 2. Please state whether Carnegie Brothers & Co., Limited, or their predecessors in that business have any licenses from George Asmus to use the Luermann improvement in blast furnaces; and, if so, state all you know, and produce any papers you have bearing thereon.

Ans. I find among the records in my office two licenses from

George Asmus granting to the Edgar Thomson Steel Co., Limited, the right to use Luermann's improvements in blast furnaces, and I would say in connection with that that the Edgar Thomson Steel Co., Limited, were the owners at the date of these licenses of the blast furnaces which are now owned by Carnegie Brothers & Co., Limited. I also hold the vouchers showing the payment of the license fees, signed by Mr. George Asmus. One of these licenses is dated the 11th day of April, 1879; it covers Edgar Thomson furnace A,
229 and an arrangement to grant other licenses at the same rate. The license for furnace A was granted for the sum of $1,000. The receipt for the payment of the amount due under that license I now produce, which is a voucher showing the payment to Mr. Asmus of $1,000 for furnace A; also voucher dated April 27, 1880, covering payment of $1,000 for furnace B. The other license, dated the 15th day of March, 1881, grants the right to use said patent at Lucy furnace No. 2, in Pittsburgh, and furnaces C, D, and E, at the Edgar Thomson furnaces at Bessemer, Pa. The consideration for the use of the patent in the last-named four furnaces was three thousand five hundred dollars ($3,500), to cover the payment of which I now produce two vouchers, both dated March 5, 1881, one for $2,666.66 of the Edgar Thomson Steel Co., Limited, and the other for $833.34 of the Lucy Furnace Co. I also produce the letter of March 14, 1881, referred to in the two vouchers, and the acceptance thereof.

Int. 3. Can you explain the reason for the reduction in price which appears in Lucy No. 2 and furnaces D and E of the Edgar Thomson?

Ans. The contract was made with Mr. T. M. Carnegie, who is dead, but my understanding is that the reduction was on account of the number of furnaces.

Copies of the foregoing papers are here produced for inspection of counsel and the master and are now offered in evidence, in the order given by the witness, as "Complainant's Exhibits A, B, C, D, E, F, G, and H."

Cross-examination by Mr. BALDWIN:

X Int. 4. What was the largest diameter across the boshes of furnace A?

Ans. I cannot answer the question from my own personal knowledge.

X Int. 5. Was it a large or small furnace?

Ans. I would say that it is the smallest of the Edgar Thomson furnaces.

230 X Int. 6. Are the Edgar Thomson furnaces generally regarded as large or small sized furnaces?

Ans. Large size, with the exception of A.

It is agreed that the Edgar Thompson and Lucy furnaces referred to in the foregoing testimony are the same furnaces spoken of by Julian Kennedy in answer to Int. 4 of his evidence in this case,

and that the sizes of said furnaces are correctly given by Mr. Kennedy.

S. E. MOORE.

WILLIAM J. MOORHEAD, a witness produced on behalf of complainant, being duly sworn, deposes and says as follows:

Int. 1. State your name, age, residence, and occupation.

Ans. William J. Moorhead; age, 46 years; residence, Pittsburgh, Pa.; occupation, I am a member of the firm of Moorhead, McCleane & Co., iron manufacturers.

Int. 2. Please state whether your firm procured a license from George Asmus to use the Luermann patent in your blast furnace; and, if so, state the price and when you procured the license.

Ans. We procured the license from George Asmus May 21, 1880, and paid him one thousand dollars ($1,000).

Int. 3. Have you a written license from him?

Ans. I presume we have. My recollection is that he gave us the right to use the patent in the receipt he gave for the money. I will produce the receipt or a copy thereof.

(Said receipt is offered in evidence and marked "Complainant's Exhibit I.")

Cross-examination by Mr. BALDWIN:

X Int. 4. What was the largest diameter of that furnace across the boshes?

Ans. Eighteen feet.

WM. J. MOORHEAD.

231 EXHIBIT A.

Contract and License to Use Luermann's Improvement in Blast Furnaces.

In consideration of the sum of one thousand dollars ($1,000), receipt of which is hereby acknowledged, I herewith sell to the Edgar Thomson Steel Co., Limited, the right to use "Luermann's improvement in blast furnaces," patented November 5, 1867, reissued November 4, 1868, United States patent No. 3204, at one furnace belonging to and about to be erected by said company, the said sum of one thousand dollars being in full consideration for the use of said improvement at such furnace for all the time the patent has to run and for any extension, reissue, or renewal thereof that may be granted hereafter.

And I further agree with the Edgar Thomson Steel Co., Limited, to grant them the right to use "Luermann's improvement" in any and all other blast furnaces which said company may build or own hereafter by paying me one thousand dollars for the use of said patent for each of such furnaces at the time of the blowing in.

Witness my hand and seal this eleventh day of April, A. D. 1879.

[SEAL.] GEORGE ASMUS.

EXHIBIT B.

The Edgar Thomson Steel Co., Limited, to George Asmus, Dr.

April 10, 1879. Consideration for license to use Luermann's improvement in blast furnaces in "furnace A," as per contract this date $1,000

I certify that the above account is correct, and that the expense was incurred for the benefit of the Edgar Thomson Steel Co., Limited.

E. V. McCANDLESS.

Approved for payment.
WM. P. SHINN, *General Manager.*

232 Received ——, 187–, of the Edgar Thomson Steel Company, Limited, one thousand dollars in full for the above account.

$1,000. GEORGE ASMUS.

EXHIBIT C.

The Edgar Thomson Steel Co., Limited, to George Asmus, Dr.

APRIL 27, 1880.

Consideration for license to use "Luermann's improvement in blast furnaces" in "furnace B," as per contract April 11, 1879 ..... $1,000

I certify that the above account is correct, and that the expense was incurred for the benefit of the Edgar Thomson Steel Company, Limited.

S. E. MOORE, *Auditor.*

Approved for payment.
T. M. C., *Chairman.*

Received April 27, 1880, of the Edgar Thomson Steel Co., Limited, one thousand dollars in full for the above account.

$1,000. GEORGE ASMUS.

EXHIBIT D.

In consideration of the sum of three thousand five hundred dollars ($3,500), receipt of which is hereby acknowledged, I herewith sell to the Edgar Thomson Steel Co., Limited, the right to use "Luermann's improvement in blast furnaces," patented November 5, 1867, reissued November 4, 1868, United States patent No. 3204, at Lucy furnace No. 2, in Pittsburgh, and furnaces C, D, and E, at the E. T. S. works, at Bessemer, Pa., the said sum of $3,500 being in full consideration for the use of said improvement at such furnaces for all the time the patent has to run and for any ex-
233 tension, reissue, or renewal thereof that may be granted hereafter of improvements.

Witness my hand and seal this 15th day of March, 1881.
[SEAL.] GEORGE ASMUS.

EXHIBIT E.

The Edgar Thomson Steel Co., Limited, to George Asmus, Dr.

March 14, 1881. In consideration for license to use Luermann's improvements in blast furnaces in E. T. S. furnaces, at Bessemer, as follows: In furnace C, as per contract dated April 11, 1879	$1,000 00
In furnaces D and E, as per contract dated March 14, 1881, $833.33 each	1,666 66
	$2,666 66

I certify that the above account is correct, and that the expense was incurred for the benefit of the Edgar Thomson Steel Company, Limited.

S. E. MOORE, *Auditor.*

Approved for payment.
T. M. C., *Chairman.*

Received March 15, 1881, of the Edgar Thomson Steel Co., Limited, two thousand six hundred and sixty-six dollars and sixty-six cents in full of the above account.
$2,666.66. GEORGE ASMUS.

EXHIBIT F.

Lucy Furnace Company to George Asmus, Dr.

March 15, 1881. For right to use the Luermann front in Lucy furnace No. 2, as per contract, March 14, addressed to T. M. Carnegie, chairman	$833 34

234 I certify that the above account is correct, and that the expense was incurred for the benefit of the Lucy Furnace Co.
H. M. CURRY.

Approved for payment.
J. W. L.

Received March 15, 1881, of the Lucy Furnace Co. eight hundred and thirty-three dollars and thirty-four cents in full for the above account.
$833.34. GEORGE ASMUS.

EXHIBIT G.

The Edgar Thomson Steel Company, Limited.

T. M. Carnegie, Esq., chairman, &c., Pittsburgh.

DEAR SIR: I hereby agree to sell you for the sum of twenty-five hundred dollars the right to use the Luermann patent front in your

Lucy furnace No. 2 and furnaces D and E, at the Edgar Thomson steel works.

Yours truly, GEORGE ASMUS.

Pittsburgh, March 14, 1881.

EXHIBIT H.

Edgar Thomson Steel Co., Limited.

PITTSBURGH, *March* 14, 1881.

George Asmus, Esq., Pittsburgh.

DEAR SIR: We hereby accept your proposition of this date to sell us the right to use the Luermann patent front in Lucy furnace No. 2 and furnaces D and E, at the Edgar Thomson steel works, for the sum of twenty-five hundred dollars ($2,500).

Yours truly, T. M. CARNEGIE,
Chairman E. T. S. Co., L't'd, and Pres't Lucy F'ce Co.

235 EXHIBIT I.

PITTSBURGH, PA., *May* 21, 1880.

Received of Moorhead, McCleane & Co. one thousand dollars ($1,000), covering license for their use of the improvement in blast furnaces technically known as Luermann patent.

GEORGE ASMUS.

Before the Master.

Testimony of witnesses taken on behalf of complainant before W. B. Corwin, notary public, on March 22, 1887, at the office of Bakewell and Kerr, No. 110 Diamond street, Pittsburgh, Pa.

Present: Thomas W. Bakewell, Esq., appearing for W. Bakewell, Esq., counsel for complainant, and William D. Baldwin, Esq., on behalf of defendants.

WALTER KENNEDY, a witness produced on behalf of complainant, being duly sworn, deposes and says as follows:

Int. 1. State your name, age, residence, and occupation.

Ans. Walter Kennedy; age, 26 years; residence, Pittsburgh, Pa.; occupation, furnace manager.

Int. 2. What furnaces have you charge of?

Ans. Lucy furnaces, Pittsburgh, Pa.

Int. 3. How many furnaces do the Lucy furnaces include?

Ans. Two.

Int. 4. State whether or not the drawing marked "Complainant's Exhibit Kennedy," on page 24 of complainant's record in this case, represents the construction of cinder tap in use at the Lucy furnaces.

Ans. Yes.

Int. 5. How long have you been familiar with the Lucy furnaces?

Ans. Two years.

Int. 6. State whether or not at the Lucy furnaces the flow
236 of water through the water-cooled blocks of the cinder tap is varied for the purpose of regulating the flow of slag from the furnace.

Ans. No.

Int. 7. Has it ever to your knowledge been practiced so to control the slag discharge?

Ans. No, sir.

Int. 8. With what other furnaces using a similar slag-discharge arrangement are you familiar?

Ans. The Isabella, two furnaces, and the Edgar Thomson, four furnaces. There are more than that now, but at the time I worked there there were only four.

Int. 9. How long have you been familiar with these furnaces?

Ans. Isabella for two years; Edgar Thomson for four months.

Int. 10. At these furnaces or any of them is it the practice or has it been the practice to control the slag discharge by varying the temperature of the slag-discharge piece or cinder block?

Ans. Not to my knowledge.

This testimony is objected to by counsel for defendants as immaterial.

Cross-examination, reserving objections:

X Int. 11. Is there any means for regulating the flow of water around the slag-discharge opening in any of the furnaces as to which you have testified?

Ans. Yes, sir; in all of them.

Redirect examination:

Int. 12. Of what does that means consist?

Ans. It consists of a valve.

Int. 13. What is the valve used for?

Ans. The principal use it is put to is for stopping the water
237 entirely while we are changing these blocks. Another case in which it is used is if our supply of water is bad we choke down these valves so as to economize in our water.

WALTER KENNEDY.

HERMANN SCHULZE-BERGE, a witness produced on part of complainant, being duly sworn, deposes and says as follows:

Int. 1. State your name, age, residence, and occupation.

Ans. Hermann Schulze-Berge; age, 36 years; residence, Brooklyn, N. Y.; occupation, metallurgist.

Int. 2. What experience, if any, have you had with blast furnaces in this country?

Ans. I have been engaged from 1879 to 1883 as chemist for the blast-furnace works at Edgar Thomson and have had charge of the Pennsylvania furnace, near Tyrone, Pa. I have visited during that time and afterwards the largest blast-furnace works in the country.

Int. 3. How were the furnaces of the Edgar Thomson works, during this period, constructed with regard to the cinder tap?

Ans. They are closed-front blast furnaces with water-cooled cinder outlets.

Int. 4. Under what system were they constructed?

Ans. It is the Luermann system.

Int. 5. How many furnaces do you mean when you speak of the Edgar Thomson furnaces?

Ans. In 1879 they commenced to build them, and they had four running in 1883 and 1884.

Int. 6. What system of cinder tap was used at the Pennsylvania furnace and when did you have charge of it?

Ans. The Luermann system was used at the Pennsylvania furnace, and I had charge from the spring of 1880 to the fall—from March to about September.

Int. 7. In the Edgar Thomson furnaces and the Pennsyl-
238 vania furnace or any of them has it been the practice to control the slag discharge by varying the temperature of the slag-discharge piece or cinder block?

Ans. No.

Int. 8. Look at the list of furnaces on page- 8 and 9 of complainant's paper book in this case and state which of these furnaces you visited during the period referred to in question 2.

Ans. The Norton iron works, Cambria iron works, Bethlehem iron works, Isabella furnaces, Brown, Bonnell & Co., Edgar Thomson furnaces, Lucy furnaces, Longdale Iron Co., the Low Moor Iron Co., Soho furnaces.

Int. 9. How were these furnaces constructed with regard to their cinder tap?

Ans. They were all provided with the Luermann cinder arrangement.

Int. 10. In these furnaces or any of them was it the practice to control the slag discharge by varying the temperature of the slag-discharge piece or cinder block?

Ans. No; not to my knowledge.

Int. 11. In all the furnaces which you have mentioned how was the slag-discharge piece cooled, if at all?

Ans. By water running through it.

Int. 12. State whether or not any of these furnaces were provided with a cinder block not cooled by water.

Ans. They were all of them provided with water-cooling arrangements.

Int. 13. What furnaces, if any, using the Luermann system do you know wherein the slag discharge is controlled by varying the temperature of the cinder block or slag-discharge piece?

Ans. There is none that I know of.

Int. 14. How many furnaces have the Cambria iron works and how many have the Soho furnaces?

Ans. The Cambria have five at Johnstown, Pa.; the Soho, two.

239 (Defendants' counsel objects to this deposition as immaterial.)

Cross-examination, reserving objections:

X Int. 15. For what purpose and at whose request did you visit these various furnaces about which you have testified?

Ans. Partly for my own information and partly in the interest of George Asmus, the plaintiff in these suits.

Int. 16. What was the object of your visit so far the interests of Asmus were concerned?

Ans. I informed myself about the cinder-discharge arrangement—how it had been worked and whether it had been worked satisfactorily. All these furnaces had been licensed by Asmus before I visited them except the Longdale Iron Co. and the Low Moor.

X Int. 17. Were all these furnaces you visited provided with apparatus for regulating the flow of water through the slag-discharge pieces or cinder blocks?

Ans. They were provided with stop-cocks or similar arrangements to stop off the water entirely, which is an absolute necessity in order to exchange or replace any water-cooling plate or arrangement.

X Int. 18. Did not that provision necessarily involve the capacity of increasing or diminishing the flow of water through the cinder block while the furnace was in operation?

Ans. It might be used for such purpose. However, it practically never is used for it.

(Answer objected to as argumentative and irresponsive.)

X Int. 19. How much time did you spend in visiting the Norton iron works, at Ashland, Kentucky?

Ans. I was there one day.

X Int. 20. How about the Longdale and Low Moor furnaces, in Virginia?

240 Ans. I was there one day on each of them.

X Int. 21. How, then, with this short experience can you testify as positively as you have done in your 18th answer that the stop-cock arrangement was never practically used for increasing or diminishing the flow of water, but only for turning it on or shutting it off?

Ans. It never, to my knowledge, has been used for any other purpose.

HERMANN SCHULZE-BERGE.

ROBERT C. PORTER, being duly sworn, deposes and says:

Int. 1. You are the Mr. Porter who has already testified in this case?

Ans. Yes.

Int. —. With what furnaces using the Luermann cinder tap are you familiar?

Ans. With all the furnaces in Pittsburgh, and I am acquainted with a good many furnaces outside of Pittsburgh, for instance, Sharon and Youngstown, Pa.

Int. 3. How many furnaces in all?

Ans. I know of seven in Youngstown, four in Sharon and in

Pittsburgh—the Soho furnace, Edgar Thomson, Laughlin, Carrie furnace, Lucy furnaces, Isabella, Shoenberger's.

Int. 4. How long have you been familiar with the Pittsburgh furnaces?

Ans. I have been managing furnaces in Pittsburgh since 1877 with the exception of one year.

Int. 5. What arrangement, if any, do these furnaces use for cooling the cinder-discharge opening?

Ans. They use water.

Int. 6. State whether or not in any of the furnaces you have named the slag flow is controlled by varying the temperature of the discharge opening.

241 Ans. I don't know of any that change the volume of water to control the flow of cinder.

Int. 7. How long have you been manager of the Soho furnaces?

Ans. Seven years.

Int. 8. Have you ever known of the method stated in your answer No. 6 having been practiced?

Ans. I have not.

(Defendants' counsel objects to this testimony as immaterial.)

Cross-examination, reserving objections:

X Int. 9. Do any of the furnaces you have mentioned have means for changing the volume of water that circulates through the cinder block?

Ans. There is a valve in the connection to the cooler.

R. C. PORTER.

CITY OF PITTSBURGH, *State of Pennsylvania*, } ss:

I, W. B. Corwin, notary public in and for said city, do hereby certify that on the 22d day of March, 1887, I was attended by Thomas W. Bakewell, Esq., appearing for W. Bakewell, Esq., counsel for complainant, and W. D. Baldwin, Esq., counsel for defendants, and the witnesses herein named, and that the said witnesses being of sound mind and lawful age and having been by me carefully examined and sworn to testify the truth, the depositions were reduced to writing by me and signed by the witnesses in my presence.

I further certify that I am not of counsel for either of the parties to this cause or interested in the event of the same.

In testimony whereof I have hereunto set my hand and affixed my seal this 25th day of March, 1887.

[SEAL.]

W. B. CORWIN,
Notary Public.

242 In the United States Circuit Court, Eastern District of Pennsylvania. In Equity.

ASMUS *vs.* ALDEN *et als.* } No. 7. April Session, 1884.

ASMUS *vs.* FREEMAN. } No. 8.

The Lurmann Blast Furnace Reissue.

Defendants' testimony on accounting.

Proceedings Before Master.

Wayne MacVeagh, Wm. D. Baldwin, of counsel for defendants.

243 *Proceedings Before Master.*

United States Circuit Court, Eastern District of Pennsylvania.

GEORGE ASMUS *vs.* MARGARET C. FREEMAN. } No. 8. In Equity. April Session, 1884.

SAME *vs.* ALDEN. } No. 7. In Equity.

Examination of witnesses and other evidence on behalf of the defendants on the accounting, by agreement of counsel, before Howard C. Shirk, special examiner, at his office, corner of 9th and Willow streets, Lebanon, Pa.

Present: Thomas W. Bakewell, Esq., of counsel for complainant; William D. Baldwin, Esq., of counsel for defendants.

ABRAM HESS, being duly sworn, deposes and says:

By W. D. BALDWIN, Esq., of counsel for defendants:

Q. 1. State your name, age, residence, and occupation.

A. Abram Hess; aged thirty-three; Lebanon, Pa.; business manager for Robert H. Coleman's Colebrook furnaces.

Q. 2. How long have you been so engaged?

A. Since the spring of 1881.

244 Q. 3. Do you know George Asmus, the complainant in this suit? If yes, how long?

A. I know George Asmus since the year 1882. He came around re off and on.

Q. 4. State what knowledge, if any, you have of any license or enses given by said Asmus to said Coleman under the Lurmann tent involved in this suit.

A. Mr. Asmus came on and made claim to license for use of his patent. In course of time we paid him for a license for use of his

patent at four furnaces—the two Colebrook and Anthracite furnaces Nos. 1 and 2—the sum of fifteen hundred dollars, which license I produce.

(License offered in evidence, marked "Defendant's Exhibit Coleman's License."

(It is stipulated and agreed between counsel that copies, certified by the examiner, of this and other exhibits offered during this examination may be substituted for the originals with like effect and subject to the same objections, if any.

(It is admitted that the written parts of this license are in the handwriting of George Asmus, the complainant in this suit.)

Q. 5. At the time of this settlement was there any suit pending against Robert H. Coleman?

A. Suit had not been brought, but was threatened, and rather than have the expense of a lawsuit we made this settlement. There was a strong doubt in our minds whether we were infringing on the patent for which a license was claimed, but we did not care to be the defendant in a lawsuit with regard to the matter.

Cross-examination by T. W. BAKEWELL, Esq., of counsel for complainant:

X Q. 6. Where are the Colebrook furnaces?

A. Beyond the western boundary of Lebanon, Pa.

X Q. 7. When were they built?

A. They were completed in 1881 and 1882.

245 X Q. 8. Were these furnaces in blast at the time of the granting of this license?

A. They were.

X Q. 9. Where are the Anthracite furnaces?

A. At Cornwall, Pa.

X Q. 10. How large are the Anthracite furnaces?

A. About thirteen feet bosh and thirty-five or thirty-six feet in height.

X Q. 11. Were these furnaces in blast at the time of the grant of this license?

A. One of them was, if not both. They were built in 1849 and 1852. About this time No. 1 may have been temporarily abandoned as a furnace and used as an ore-roaster. Now it is used as a furnace.

X Q. 12. How long is it since No. 1 has been used as an ore-roaster?

A. It may be three or four years; it may not be so long as three years.

X Q. 13. For how long a time now has No. 1 Anthracite furnace been in blast?

A. As soon as the changes could be made after it was abandoned as an ore-roaster. It has been in blast ever since, except during stoppages for repairs.

X Q. 14. About how long did it take to make the necessary repairs you speak of?

A. Possibly four or five months.

X Q. 15. Has the Anthracite furnace No. 2 been in use as a blast furnace continuously since the date of this license?

A. It has, except during necessary stoppages for repairs.

X Q. 16. These Anthracite furnaces were old-style furnaces of small capacity?

A. They were, and still are.

X Q. 17. As I understand you, there was a belief on your part that the furnaces you have mentioned in your direct testi-
246 mony were not closed-breast furnaces, having a water-cooled cinder outlet, within the meaning of the patent?

(Objected to as assuming facts not stated by the witness and as calling for a construction of the patent on his part as to which he has not been qualified.)

A. The question of the closed-front furnace never entered into our discussions with Asmus. It was merely in regard to tapping cinder. We did not believe we were infringing his patent, but, as there was a doubt about it, we satisfied him in preference to defending a suit.

X Q. 18. This settlement with him was, then, a compromise of the matter?

A. It was, in which he agreed to give and did give us a license.

X Q. 19. Have the Colebrook furnaces been in blast continuously since this license was granted?

A. They have, with the necessary stoppages for repairs.

ABRAM HESS.

(Deposition of Abram Hess objected to as incompetent because it proves nothing more than a compromise.)

"DEFENDANT'S EXHIBIT COLEMAN'S LICENSE."

License.

In consideration of the sum of fifteen hundred dollars paid by Robert H. Coleman, Esq., I hereby license and empower said R. H. Coleman to have and use at the two Colebrook and Anthracite furnaces No. 1 and 2, situated at Lebanon, Lebanon Co., Pa., the improvement in blast furnaces for which U. S. letters patent reissue No. 3204 are granted to George Asmus, the same being reissue of original letters patent granted to F. W. Lurmann November 5th,
247 1867, and use the same to the full end of the term for which the said letters patent are granted or may be extended hereafter.

Witness my hand and seal this 3d day of November, 1883.

GEORGE ASMUS.

The above is a true and attested copy of the original.

HOWARD C. SHIRK,
Special Examiner.

HENRY T. EUSTON, being duly sworn, deposes and says as follows:

Q. 1. State your name, age, residence, and occupation.

A. My name is Henry T. Euston; my age, forty-six years; my residence, Lebanon, Pa.; my occupation, superintendent of the Lebanon furnaces, operated by A. & H. Brock, managers for Mrs. G. D. Coleman.

Q. 2. How long have those furnaces been in blast?

A. Ever since they were built—one in 1845 and one in 1872.

Q. 3. Were those furnaces or either of them ever licensed under the Lurmann patent? If so, please produce the license.

A. They were licensed. I cannot produce a license, but I can the receipt.

(Receipt offered in evidence, marked "Defendant's Exhibit Brock's Receipt."

(The offer of this receipt objected to as being incompetent and immaterial to anything now in issue.)

Cross-examination by Mr. BAKEWELL:

X Q. 4. Are you familiar with the negotiations preceding the delivery of this receipt?

A. I am not.

248 X Q. 5. Do you know that this receipt was given on the faith of representations made by the Messrs. Brock to Mr. Asmus or his attorneys that the Lurmann improvement was not at all used on their No. 1 furnace?

A. They thought at the time that the No. 1 furnace was not constructed in accordance with the patent.

X Q. 6. A letter shown to witness and he is asked in whose handwriting the signature is.

A. Arthur Brock's.

HENRY T. EUSTON.

(Letter offered in evidence, marked "Complainant's Exhibit Brock's Letter."

(It is agreed by counsel that the receipt marked "Defendant's Exhibit Brock Receipt" was given as part of the proceedings in a suit, properly entitled, on said receipt brought against the defendants therein for an alleged infringement of the Lurmann reissued patent, and that in pursuance of said receipt said suit was discontinued.)

"DEFENDANT'S EXHIBIT BROCK RECEIPT."

United States Circuit Court, Eastern District of Pennsylvania.

GEORGE ASMUS
vs.
ARTHUR and HORACE BROCK. } No. 4. April Session, 1884. In Equity.

Received from the defendants in the above-entitled cause the sum of one thousand dollars ($1,000), settlement in full of all claims

and demands of the complainants under reissued letters patent No. 3204, dated November 24th, 1868, the said suit to be discontinued at the costs of the complainant.

JOHN M. GEST,
Solicitor for Complainants.

249 "COMPLAINANT'S EXHIBIT BROCK LETTER."

Lebanon furnaces, D. B. Coleman proprietor.

Direct all letters: Arthur and Horace Brock, managers.

LEBANON, PA., *Feb'y 27th*, 1884.

Mr. George Asmus, 57 Grand St., Pittsburgh.

DEAR SIR: Referring to your letter of February 12th, we would be very glad if you will again come to see our furnaces, particularly as to changes in cinder-tapping method.

No. 1 furnace would not come in any way under the various claims, as per circular.

If you can come we would be glad to have you advise us a few days in advance that we may be at home.

Yours very truly,
ARTHUR AND HORACE BROCK, *Managers.*

The above is a true and attested copy of original.

HOWARD C. SHIRK,
Special Examiner.

RICHARD MEILY, being duly sworn, deposes and says:

Q. 1. State your name, age, residence, and occupation.

A. My name is Richard Meily; my age, forty-eight years; my residence, Lebanon, Pa.; my occupation, iron manufacturer, and am a member of the firm of J. & R. Meily.

Q. 2. If your firm was ever licensed under the Lurmann patent please produce the license.

A. I produce this license.

(License offered in evidence, marked "Defendant's Exhibit Meily License.")

250 Q. 3. At the time of the grant of this license had you a blast furnace in operation at or near Lebanon, Pa.; and, if so, how long had said furnace been in blast?

A. We had a furnace in blast which had been built in 1868.

Q. 4. Prior to this license had suit been brought against your firm as alleged infringers of this Lurmann patent?

A. Yes.

Q. 5. How long prior to the date of this license was a demand made on you to take a license under this patent?

A. Between four and eight months.

Cross-examined by Mr. BAKEWELL:

X Q. 6. Was the writing at the foot of the license and marked

N. B. written on the license and signed by Mr. Asmus at the time of the delivery of the license to you?

A. Yes.

X Q. 7. When this suit was brought against you by Mr. Asmus did not you or your attorney, Mr. John Meily, Jr., represent to Mr. Asmus or to his attorneys that the suit was brought on a mistaken supposition of fact as to the construction of your furnace?

A. I think it was.

X Q. 8. Was it that representation which induced Mr. Asmus to settle the controversy for one hundred dollars?

A. We can't, of course, tell what induced him to settle.

X Q. 9. At the time of Mr. Asmus' suit against you was Mr. John Meily, Jr., who appeared for you as solicitor, a member of your firm?

A. No, sir.

Redirect examination:

Q. 10. Did Asmus himself examine your furnace before suing you?

A. I think he sued first.

RICHARD MEILY.

251 "DEFENDANT'S EXHIBIT MEILY LICENCE."

License.

In consideration of the sum of one hundred dollars paid by Messrs. J. & R. Meily, of Lebanon, Pa., I do hereby license and empower the said firm to have and use at one furnace, situated at Lebanon, Pa., the improvement in blast furnaces for which U. S. letters patent, reissue No. 3204, are granted to George Asmus, the same being reissue of original letters patent granted to F. H. Lurmann November 5th, 1867, and use the same to the full end of the term for which the said letters patent are granted or may be extended thereafter.

Witness my hand and seal the 22d day of May, 1884.

GEORGE ASMUS.

N. B.—The above sum has been stipulated by special agreement, the patent being nearly run out and Messrs. Meily not knowing yet how soon they will apply the improvement.

G. ASMUS.

The above is a true and attested copy of the original.

HOWARD C. SHIRK,
Special Examiner.

STATE OF PENNSYLVANIA, }
County of Lebanon. }

I, Howard C. Shirk, special examiner, do hereby certify that on this twentieth day of April, A. D. 1887, I was attended by Thomas W. Bakewell, Esq., of counsel for complainant, and William D.

Baldwin, Esq., of counsel for defendants, and the witnesses herein named, and that the said witnesses being of sound mind and lawful age and having been by me carefully examined and sworn to testify the truth, the whole truth, and nothing but the truth, the
252 depositions were reduced to writing by me and signed by the witnesses in my presence. I further certify that I am not of counsel for either of the parties in this cause or interested in the same.

In testimony whereof I have hereunto set my hand and affixed my seal the 20th day of April, 1887.

HOWARD C. SHIRK, [SEAL.]
Special Examiner.

253 And afterwards, to wit, on the ninth day of December, in the year of our Lord one thousand eight hundred and eighty-seven, the complainant, by his solicitors, comes into court here and files exceptions to the report of the master in the words and figures following, viz:

Exceptions. (*Filed Dec.* 9, 1887.)

To the honorable the judges of said court:

The said complainant, by W. Bakewell, his attorney, excepts to the report of the master, W. D. Strawbridge, Esq., in the above-entitled cause, which was filed on the 10th day of November, 1887, and for cause thereof respectfully shows—

1. That the master erred in ruling that under the evidence in the cause the complainant has not proved the existence of an established license fee for the use of the invention covered by the complainant's letters patent and adjudged by the court to have been infringed by the defendants.

2. That the master erred in not ruling that the complainant has proved an established license fee of $1,000 for use of said invention and in not reporting as being due from the said defendants to the complainant for use of said invention the sum of $1,000, with proper interest, for each furnace used by the defendants in infringement of complainant's letters patent.

3. That in reporting to the court the facts concerning the grant of licenses under the complainant's said letters patent the master has erred in that he has not stated fully all the facts and special circumstances explanatory of such grant which appear in the testimony adduced in the cause, but has omitted to state or give due weight to certain of such facts and circumstances which are material to be considered and the omission of which is prejudicial to the case of the complainant.

254 That in view of the evidence in the cause the master erred in ruling that the complainant is entitled only to nominal damages and in not ruling that the complainant is entitled to a substantial recovery.

Wherefore, and by reason of divers other good causes of exception, the said complainant prays that the said report be set aside and that

a decree be entered in favor of the complainant against the said defendants in such sum as in the judgment of the court complainant may be equitably entitled to recover.

Respectfully submitted, W. BAKEWELL,
Sol'r for Complainant.

Pittsburgh, Dec'r 9, 1887.

The foregoing exceptions of the complainant to the report of the master have been submitted to the master with the request that they be considered and passed upon by him.

The master reports that he has carefully considered said
255 exceptions, the records in said cause, and his report, and that he is of opinion that said exceptions should be overruled and dismissed.

WM. C. STRAWBRIDGE, *Master.*

Dec. 12, 1887.

(Endorsed:) U. S. circuit court, eastern district of Penna. Nos. 8 & 7. Ap'l sessions, 1884. In equity. George Asmus *vs.* Margaret C. Freeman. Same *vs.* Annie C. Alden. Exceptions to report of master and the master's report thereon. Filed 12 Dec., 1887.

256 And afterwards, to wit, on the twenty-ninth day of March, in the year of our Lord one thousand eight hundred and eighty-eight, come the parties aforesaid, by their counsel aforesaid, and this cause being called for argument on exceptions to the report of the master and having been argued by counsel for the respective parties, and the court, not being fully advised in the premises, takes further time to consider thereof.

And afterwards, to wit, on the second day of April, in the year of our Lord one thousand eight hundred and eighty-eight, come the parties aforesaid, by their counsel aforesaid, and the court, being now fully advised in the premises, delivers the following opinion, viz:

257 ASMUS
vs.
FREEMAN.

BUTLER, *J.:*

The report shows such intelligence and care that we feel hesitation in disagreeing with the learned master. We are unable, however, to accept his conclusion in one important respect.

To show the extent of damage sustained, the complainant undertook to prove the existence of a uniform license fee. In this the master thinks he failed. The rule requires a uniform fee within given periods, such as indicates the market value of a license at the times specified. It need not be uniform throughout the life of the patent and could not be. As the monopoly approaches its
258 close the value necessarily diminishes and the price of its use must be correspondingly less. Nor is it important that a

larger or smaller sum is demanded and paid under special circumstances, as where licenses result from the settlement of suits for or controversies about imfringements. Here, as in all extraordinary cases, other considerations than the value of a license enter. It is sufficient that the price is uniform when the circumstances are similar and such as ordinarily exist when these contracts are made.

The proofs here show that the license fee demanded and paid in the beginning was one hundred and fifty dollars per foot across the boshes, averaging about $1,500 per furnace, and later one hundred dollars—about $1,000 per furnace. After some years it was placed at one thousand dollars per furnace, regardless of size. This
259 latter sum was thereafter adhered to uniformly under ordinary circumstances, and many licenses were taken at that rate. It was never departed from except where licenses arose from the settlement of suits for or controversies about infringement and in one or two instances where several licenses were granted together toward the expiration of the patent, and these, as well as other unusual circumstances, operated to induce and justify a reduction. When the master says no reason is given for this latter reduction he must be understood as meaning no sufficient reason. The proofs show the reasons above stated, and we think them sufficient to justify the reduction and exclude these licenses from consideration.

As respects the infringements here involved, two commenced
260 in the summer of 1878 and the third in 1881. These are the periods, therefore, to which inquiry must be directed, and we think the proofs show the existence at both times of a well-established and uniform fee of one thousand dollars demanded and paid under ordinary circumstances.

The complainant must therefore have a decree for three thousand dollars. Whether interest should be added has not been considered. The question was not presented on the argument and is open to doubt.

We find no substance in the objection that the device covered by claim 7 was not used by respondent. The claim infringed (the first) covered the entire invention. The seventh is structural merely, covering a method of constructing the "slag-discharge piece"
261 so as to regulate the cooling process embraced in the first. The master did not pass on this question. We may infer, however, from what is said that he considered it immaterial. The general rule is that where less than the whole number of claims has been infringed, evidence must be adduced to show the value of the part taken. This is inapplicable, however, where, as here, the claim infringed embraces the whole invention, and the others are simply structural. Wescott *vs.* Rude, 10 Fed. Rep., 830; Willimantic Thread Co. *vs.* Clark Thread Co., 27 Fed. Rep., 367; Cleon Tondeur vs. Stewart, Upp & Co., No. 14, Nov. term, 1885, circuit court, western dist. Penna.

The respondent admits that the several claims between the first and seventh are of this character. We think it reasonably
262 plain that the seventh also is. Furthermore, the proofs show that the license fee paid was the value placed on the use of

the invention irrespective of the device covered by the seventh claim. While it is not shown that this device was ever used, it is shown that generally it was not. It seems to have been regarded as valueless, and for this reason was not used by the respondent. The master reports that "it was admitted by their counsel in argument before the master that the respondents did not regard the method of claim 7 as being of any practical value, and that had they so regarded it they would have adopted and practiced it."

This view respecting the value of the seventh claim is of itself conclusive. It is said the master is mistaken respecting the
263 imputed admission. However this may be, he virtually reports the matter covered by the claim as valueless, and the proofs seem to justify this conclusion.

(Endorsed:) No. 8. April sess., 1884. C. C. U. S., E. D. of Pa. Asmus *vs.* Freeman. Opinion. Filed Apr. 2, 1888.

264 And afterwards, to wit, on the twelfth day of October, in the year of our Lord one thousand eight hundred and eighty-eight, the court enters the following decree, viz:

265 In the United States Circuit Court, Eastern District of Pennsylvania.

GEORGE ASMUS
versus
MARGARET C. FREEMAN. } No. 8. April Sessions, 1884. In Equity.

Final Decree.

And now, October 12, 1888, this case having come on to be heard on exceptions filed by the complainant to the report of the master and having been argued by counsel for the respective parties, on consideration thereof the said exceptions are sustained; and it is ordered, adjudged, and decreed as follows: That the interlocutory decree heretofore entered on July 19, 1886, be made final, and that the said defendant pay to the said complainant as damages for infringement of said letters patent the sum of one thousand
266 dollars and the cost of suit, amounting to one hundred and sixteen $\frac{5}{100}$ dollars.

(Endorsed:) No. 8. April session, 1884. George Asmus *vs.* Margaret Freeman. Final decree. Filed Oct. 12, 1888.

267 And afterwards, to wit, on the fourth day of December, in the year of our Lord one thousand eight hundred and eighty-eight, the respondent, by her solicitors, comes into court here and prays an appeal to the Supreme Court of the United States in the words and figures following, viz:

268 United States Circuit Court, Eastern District of Pennsylvania. In Equity.

GEORGE ASMUS, Complainant,
vs.
MARGARET C. FREEMAN, Defendant. } No. 8. April Sessions, 1884.

To the honorable the circuit court of the United States for the eastern district of Pennsylvania:

The appeal of Margaret C. Freeman, the above-mentioned defendant and appellant, respectfully showeth that on or about the seventh day of March, 1884, the above-mentioned complainant, George Asmus, filed his bill of complaint in this suit in the circuit court of the United States for the third circuit and eastern district of Pennsylvania against the above-mentioned defendant, Margaret C. Freeman, in a suit in equity to enjoin said defendant from
269 infringing letters patent of the United States No. 70447, granted November 5, 1867, to one F. W. Lurmann, for an improvement in blast furnaces, and reissued as No. 3204 November 24, 1868, to said complainant as assignee of said Lurmann, and praying that said defendant might be decreed to account for and pay over any income unlawfully derived from the violation of the alleged rights of said complainant, and for such other relief as the equity of the case should require and to said court might seem meet.

That your petitioner duly filed her answer to said bill of complaint—

1st. Denying the novelty of said Lurmann's alleged improvements in blast furnaces, in support of which allegation the requisite particulars of prior description in certain U. S. and foreign letters patent and publications were set forth.

270 2nd. Alleging the invalidity of the reissued letters patent, because—

(*a*) The surrender of the original letters patent was not made for good and lawful cause.

(*b*) The reissued letters patent were not granted for the same invention as that described and claimed in the original letters patent.

(*c*) The reissued letters patent were obtained on the application of the said assignee without the knowledge or consent of the inventor for the purpose of expanding and enlarging the claims thereof so as to cover an invention other and different from that claimed and described in the original letters patent, and that the said reissued letters patent as allowed and issued were unlawfully and unwarrantably expanded and enlarged to cover inventions other and
271 different from and broader than those described and claimed in said original letters patent.

(*d*) The want of patentable subject-matter in the claims.

(*e*) The insufficiency of the specification.

(*f*) That there was no patentable combination between the elements constituting the first claim of said reissued letters patent, and that no invention was required to produce the same.

3rd. Denying infringement.

4th. Alleging that the only furnace used by said defendant was constructed in substantial accordance with letters patent No. 209,119, granted October 22, 1878, to Henry C. Grittinger, manager of defendant's works, with the exception of the omission of the water-cooling pipe in the weight plate around the slag-discharge opening, the use of such water pipe having been for some time
272 discontinued, this defendant not using any water-cooled arrangement to regulate the control of flow of slag through the furnace.

That complainant replied to said answer.

Whereupon testimony was taken and such proceedings were had in the cause that on or about the nineteenth day of July, 1886, an interlocutory decree was rendered in said circuit court, wherein it was in substance adjudged that the defendant had infringed the first claim of the aforesaid letters patent.

That complainant should recover all gains and profits by defendant made and the damages sustained by the complainant, as well as the costs and charges to be duly taxed, and that the cause be referred to a master to ascertain the amount of such gains and profits
273 and of the damages sustained by said complainant.

Whereupon *said* proceedings were had that the master reported that said complainant was entitled to nominal damages of six cents.

The exceptions to the master's report were filed before said court by said complainant.

Whereupon the said exceptions were sustained, and on or about the twelfth day of October, 1888, it was decreed that the interlocutory decree heretofore entered be made final, and that the said defendant pay to said complainant as damages for the infringement the sum of $1,000 and the costs of suit, amounting to $116.55; which said judgment and decree is, as this appellant is advised, erroneous and ought to be reversed.

Whereupon this appellant appeals from the said decree in the said circuit court to the Supreme Court of the United
274 States, and respectfully prays that the said decree of said circuit court and the bill of complaint, answer, replication, depositions, evidence, and proceedings in the said cause may be sent to the Supreme Court of the United States without delay, and that the Supreme Court will proceed to hear the cause anew, and that the said decree of the circuit court and every part thereof may be reversed or *said* other decree made as to the said Supreme Court shall seem best.

MARGARET C. FREEMAN.

DISTRICT OF COLUMBIA, *City of Washington*, } *ss:*

Margaret C. Freeman, being duly — according to law, deposes and says that the facts set forth in the foregoing petition are
275 true to the best of her knowledge and belief.

MARGARET C. FREEMAN.

— and subscribed before me this twenty-eighth day of November, A. D. 1888.

GEORGE W. BAGG,
Notary Public.

[SEAL.]

(Endorsed:) 8. April sess., 1884. C. C. U. S. George Asmus *vs.* Margaret C. Freeman. Petition of appeal. Filed Dec. 4, 1888. Baldwin, MacVeagh.

276 In the Circuit Court of the United States in and for the Eastern District of Pennsylvania, in the Third Circuit.

GEORGE ASMUS, Complainant,
vs.
MARGARET C. FREEMAN, Defendant. } No. 8. April Sess., 1884.

Know all men by these presents that we, Margaret C. Freeman and William C. Freeman, are held and firmly bound unto the above-named George Asmus in the sum of three thousand dollars, to be paid to the said complainant, his certain attorney, executors, administrators, or assigns; to which payment, well and truly to be made, we bind ourselves, our respective heirs, executors, and administrators, jointly and severally, by these presents.

Sealed with our seals and dated this twenty-eighth day of November, A. D. 1888.

Whereas lately, at a circuit court of the United States in and for the eastern district of Pennsylvania, in the third circuit, in a suit depending in the said court between George Asmus, complainant, and Margaret C. Freeman, defendant, a final decree was rendered against the said defendant, and the said defendant having taken an appeal, which appeal has been allowed by the said circuit court, to the Supreme Court of the United States to reverse the said decree in the aforesaid suit:

277 Now, the condition of this obligation is such that if the said Margaret C. Freeman shall prosecute her said appeal to effect and answer all damages and costs if she fail to make her appeal good, then this obligation to be null and void; otherwise to remain in full force and virtue.

MARGARET C. FREEMAN. [SEAL.]
WM. C. FREEMAN. [SEAL.]

Sealed and delivered in the presence of—
SARAH H. COLEMAN,
GEORGE W. BAGG,
As to M. C. F.
HENRY C. GRITTINGER,
A. M. KEISER,
As to W. C. F.

Approved.
WM. BUTLER, *Judge.*

[Endorsed:] No. 8. April sess., 1884. Circuit court United States. Asmus *vs.* Freeman. Bond surappeal. Approved and filed Dec. 4, 1888. Samuel Bell, clerk.

278 THE UNITED STATES OF AMERICA, *ss:*

To George Asmus, Greeting:

You are hereby cited and admonished to be and appear at a Supreme Court of the United States, to be holden at Washington on the second Monday of October next, pursuant to an appeal filed in the clerk's office of the circuit court of the United States for the eastern district of Pennsylvania, in the third circuit, wherein Margaret C. Freeman is appellant and you are appellee, to show cause, if any there be, why the decree rendered against said appellant, as in said appeal mentioned, shall not be corrected and why speedy justice should not be done to the parties in that behalf.

Witness my hand this fourth day of December, in the year of our Lord one thousand eight hundred and eighty-eight.

WM. BUTLER, *Judge.*

I accept service of the above citation.

W. BAKEWELL,
Attorney for George Asmus.

December 6th, 1888.

279 UNITED STATES OF AMERICA, } *sct:*
Eastern District of Pennsylvania, }

I, Samuel Bell, clerk of the circuit court of the United States of America for the eastern district of Pennsylvania, in the third circuit, do hereby certify the foregoing to be a true and faithful copy of the original pleas and proceedings in the case of George Asmus *vs.* Margaret C. Freeman, No. 8, April session, 1884, on file and now remaining among the records of the said court in my office.

Seal U. S. Circuit Court, E. D. Pennsylvania.

In testimony whereof I have hereunto subscribed my name and affixed the seal of the said court, at Philadelphia, this third day of January, in the year of our Lord one thousand eight hundred and eighty-nine, and of the Independence of the United States the one hundred and thirteenth.

SAMUEL BELL,
Clerk of C. C.

Endorsed on cover: Case No. 13,482. E. Pennsylvania C. C. U. S. No. 323. Margaret C. Freeman, appellant, *vs.* George Asmus. Filed January 30, 1889.

IN THE SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1891.

MARGARET C. FREEMAN, Appellant,
vs.
GEORGE ASMUS. } No. 323.

The following stipulation, a copy of which is hereto attached, having been entered into in this case in the circuit court, and the same having been omitted from the transcript of the record filed in this court on appeal, it is hereby stipulated and agreed by & between the counsel for the respective parties that the said stipulation shall be added to the transcript of the record of said case in this court with like effect as if the same had been certified to this court as a part of the record.

W. D. BALDWIN,
Of Counsel for Appellant.
W. BAKEWELL,
Of Counsel for Appellee.

Washington, April 19, 1892.

United States Circuit Court, Eastern District of Pennsylvania.

GEORGE ASMUS
vs.
ANNIE C. ALDEN. } No. 7. April Sessions, 1884.

GEORGE ASMUS
vs.
MARGARET C. FREEMAN. } No. 8. April Sessions, 1884.

It is hereby stipulated between counsel that the following facts may be considered as proved and admitted by defendants in regard to the number, size, and time of operation of defendants' furnaces, alleged to infringe complainant's patent, to wit, that three furnaces, each fifteen feet diameter across the boshes, were built and operated at the following dates, viz:

North Cornwall furnace, started in the summer of 1878.

Bird Coleman No. 1, started in the fall of 1878.

Bird Coleman No. 2, built in 1880 and started in 1881.

All said furnaces continued in operation until the expiration of complainant's patent.

(Signed) WILLIAM D. BALDWIN,
Of Counsel for Defendants.

September 7, 1887.

[Endorsed :] Case No. 13,482. Supreme Court U. S., October term, 189–. Term No., 323. Margaret C. Freeman, app't, *vs.* George Asmus. Stipulation and addition to record. Filed Apr. 19th, 1892.

Office Supreme Court U. S.
FILED.
APR 15 1892
JAMES H. McKENNEY.
CLERK.

IN THE

Supreme Court of the United States.

No. 323.—October Term, 1891.

MARGARET C. FREEMAN, Appellant,

vs.

GEORGE ASMUS, Appellee,

The Closed Breast Blast Furnace

REISSUE.

APPELLANT'S BRIEF.

WAYNE MacVEAGH,
W. D. BALDWIN,
Counsel for Appellant.

WASHINGTON:
JOSEPH L. PEARSON, PRINTER,
Corner 9th and D streets.
1892.

Supreme Court of the United States.

No. 323.—October Term, 1891.

Margaret C. Freeman, Appellant, *vs.* George Asmus, Appellee. } The Lurmann Blast Furnace Reissue.

APPELLANT'S BRIEF.

STATEMENT OF THE CASE.

(Note.—The references throughout are to the printed record herein, unless otherwise stated.)

Proceedings in the Court Below.

March 7, 1884, George Asmus, appellee here and complainant below, filed his bill in equity in the Circuit Court of the United States for the Eastern District of Pennsylvania, charging this appellant, defendant below, in the usual form, with infringement of reissued letters-patent No. 3,204, granted to him November 24, 1868, for an Improvement in Blast Furnaces, as assignee of F. W. Lurmann's original letters-patent No. 70,447, dated November 5, 1867, and praying an answer under oath, an injunction, an account of profits, an assessment of damages, and general relief. (pp. 1–3.)

May 17, 1884, answer filed. (pp. 4–9.)

June 14, 1884, replication filed. (p. 11.)

May 5, 1886, case argued on pleadings and proof. (p. 119.)

May 14, 1886, opinion and decision filed. (pp. 120–124.)

August 19, 1886, decree rendered that the reissued letters-patent were valid; that defendant had infringed the first claim thereof, and case referred to a master to ascertain damages. (p. 124.)

November 10, 1887, master filed report, finding complainant entitled only to *nominal damages* of six cents. (pp. 125–128.)

December 9, 1887, complainant filed exceptions to master's report. (p. 149.)

December 12, 1887, master reported that, in his opinion, said exceptions should be overruled and dismissed. (p. 150.)

March 29, 1888, exceptions argued before the court. (p. 150.)

April 2, 1888, court rendered opinion sustaining exceptions to the master's report. (p. 152.)

October 12, 1888, final decree rendered against appellant for costs and damages, $1,116.05. (p. 154.)

December 4, 1888, appeal and bond filed, and approved, and citation issued and served. (pp. 153–155.)

The Questions Involved.

The answer sets up the following defenses, viz:

1. It denies the novelty of Lurmann's alleged improvements. (p. 5.)

2. It alleges the reissue to be invalid for the following reasons: (p. 5.)

First. The surrender of the original letters-patent was not made for good and lawful cause. (p. 5.)

Second. The reissued letters-patent were not granted for the same invention as that described and claimed in the original letters-patent. (p. 5.)

Third. "Said reissued letters-patent were obtained on the application of an assignee, and without the knowl-

edge or consent of the inventor, for the purpose of enlarging and expanding the claims thereof so as to cover an invention, other and different from that claimed and described in said original letters-patent, and that the said reissued letters-patent, as allowed and issued, were unwarrantably expanded and enlarged to cover inventions other and different from that described and claimed in said original letters-patent, and that said reissued letters-patent, as allowed and issued, were unlawfully and unwarrantably expanded and enlarged to cover inventions other and different from, and broader than those described and claimed in, said original letters-patent, and that said reissued letters-patent are therefore void." (p. 5.)

Fourth. The want of patentable subject-matter in the claims. (p. 7.)

Fifth. The insufficiency of the specification. (p. 7.)

Sixth. There is no patentable combination between the elements constituting the first claim of said reissued letters-patent, and no invention was required to produce the same. (p. 7.)

3. It denies infringement. (p. 6.)

4. It alleges that the only furnace used by defendant "was constructed in substantial accordance with letters-patent No. 209,119, granted October 22, 1878 to Henry C. Grittinger, manager of defendant's works, *with the exception of the omission of the water-cooling pipe in the weight plate and around the slag-discharge opening*, the use of such water pipe having been for some time discontinued, *this defendant not using any water-cooling arrangement to regulate the control of flow of slag through the furnace.*" (p. 7.)

See Answer, (pp. 4–9,) Petition for Appeal, (pp. 153–154.)

Assignment of Errors.

The court below erred in the following particulars:

1. In deciding Lurmann's alleged improvement to be novel and patentable;

2. In deciding the reissued letters-patent No. 3,204, granted to appellee as assignee of said Lurmann, to be good and valid;

3. In deciding said Lurmann to be the first and original inventor of the improvement in said reissued leters-patent described and claimed;

4. In deciding the matter covered by the first claim of said reissue to have been embraced in the original patent;

5. In deciding the first claim of said reissue to be novel and patentable;

6. In deciding said first claim to be valid, as not enlarging the original invention;

7. In misapprehending the state of the art, as shown in the record;

8. In deciding appellant to have infringed the first claim of said reissue;

9. In overruling and reversing the report and finding of the master that he was unable to find that the complainant had proved an established license fee, and awarding nominal damages only for defendant's alleged infringement;

10. In awarding as damages the full license fee or royalty claimed to have been established by complainant for the use of all the claims of the patent, as compensation for an alleged infringement of defendant by the use of the subject-matter of one claim only, and that for a limited period of the life of the patent;

11. In awarding complainant as damages for said limited alleged infringement a license fee or royalty larger than was proved to have been accepted by complainant from other alleged infringers, under like circumstances;

12. In deciding appellant, in effect, to be bound by a decree in another suit to which she was neither party nor privy, and in which the question of the validity of the reissue was not raised or considered;

13. In not dismissing complainant's bill for want of equity.

Abstract of Pleadings.

The bill recites:

I. That, prior to November 5, 1867, "Lurmann was the true, original, and first inventor of a certain new and useful improvement in blast furnaces, not known or used before, and *not for more than two years prior to the date of his application for a patent in public use or on sale with his consent or allowance.*" (p. 1.)

II. Lurmann, having made due application therefor, and in all respects complied with the conditions of the then existing law of Congress, obtained letters-patent of the United States, No. 70,447, dated November 5, 1867, for his said invention, and, having assigned his invention and letters-patent to appellee, the latter, for good and lawful cause, surrendered said letters-patent, and obtained a reissue in accordance with law for the residue of the term thereof. (p. 1.)

III. Alleges appellee to have caused said improvement to be extensively applied to practical use, and granted a large number of licenses to use it, and has been, and but for infringement by defendant *and others* would still be, in undisputed possession, use, and enjoyment of the exclusive privileges secured by said reissue, and in receipt of the profits thereof. (p. 2.)

IV. Recites bringing suit against Dunbar Furnace Co. and others for infringement of said reissue; that defendants filed answer denying validity of reissue, novelty of invention therein described and claimed, and infringement by them; issue joined, proofs taken, and cause presented by counsel for both parties; Judge McKennan gave a decree sustaining said reissue as valid, and granting an injunction and account, all of record and unreversed, as No. 215, November term, 1877. (p. 2.)

V. Charges that defendant, well knowing all these facts, is constructing and using blast furnaces in some parts

thereof substantially the same in construction and operation as in said reissue mentioned, the exclusive right and privilege to make and use which and vend to others to be used is by law vested in orator. (p. 2.)

VI. Charges that defendant, without orator's license, against his will, and in violation of his rights, has made and used, and intends to still make and use, said improvements within the Eastern District of Pennsylvania, and refuses to pay orator any of the profits made by such unlawful manufacture and use, or to desist from further infringement of said reissue; all in violation of exclusive rights and privileges vested in orator under and by virtue of said reissue, and contrary to equity and good conscience, and tending to the manifest injury of orator. (p. 2.)

VII. Asks that defendant may show cause why orator should not have relief prayed, and may *make full disclosure and discovery*, and *upon oath*, and according to best and utmost of knowledge, remembrance, information, and belief, full, true, direct, and perfect answer make to matters and things stated and charged, and particularly to the following interrogations, viz:

1. Whether said original patent was granted and issued;
2. Whether said original patent was reissued to orator;
3. Whether defendant has at any time, and when and during what time, made, used, or sold any, and how many, blast furnaces constructed in whole or in part upon the principles and in the manner described in said reissue. Describe minutely and in detail their construction and operation. (p. 3.)

VIII. That defendant may answer and be decreed to account for and pay over the income or profits thus unlawfully derived, or which might have been derived from violation of orator's rights; prays court, on entering decree, to assess profits, or income, and damages, and increase actual damages three times under the circumstances of defendant's wilful and unjust infringement; prays writ

of injunction perpetually enjoining defendant from any further construction, sale, or use in any manner of said patented improvements, or any part thereof; and that a provisional or preliminary injunction be issued restraining defendant from any further infringement, and such other relief, &c. (p. 3.)

IX. Asks writ of injunction and *subpœna* for defendant to appear and answer bill, and abide by and perform such order and decree as shall seem meet. (p. 3.)

Defendant's Answer.

I. Denies that Lurmann was the inventor, or an original, true, and first inventor, of alleged improvement in blast furnaces; denies it was new and useful, and that it was not known or used before the supposed invention by said Lurmann, and that it was not, for more than two years prior to his application, *in public use and on sale in the United States, both with and without his consent or allowance.* (p. 5.)

II. Admits that Lurmann obtained patent, but denies he was the original and first inventor of said alleged invention, and that he made due application therefor, and that he in all respects complied with the conditions of the then existing law of Congress, as alleged. (p. 5.)

III. Whether said Lurmann assigned his said alleged invention defendant is not informed, save by said bill; on information and advice denies, and leaves complainant to make proof.

Admits complainant surrendered said patent and obtained reissue No. 3,204, dated November 24, 1868, but denies that said letters-patent No. 70,447 were surrendered for good and lawful cause, or that said reissue No. 3,204 was obtained or granted in accordance with law, or for the residue of the term; *denies that said reissue was for the same invention* which was specified in said original patent No. 70,447, but avers that "*said reissued letters-patent were*

obtained on the application of an assignee, and without the knowledge or consent of the inventor, for the purpose of expanding and enlarging the claims thereof, so as to cover an invention other and different from that described and claimed in said original letters-patent, and that the said reissued letters-patent, as allowed and issued, were unlawfully and unwarrantably expanded and enlarged, and cover inventions other and different from, and broader than those described and claimed in, said original letters-patent, and that said reissued letters-patent are therefore void." (p. 5.)

IV. Defendant is not informed, save by bill, whether complainant has caused said alleged improvement to be extensively applied to practical use, and granted a large number of licenses, and leaves complainant to prove, as advised. (pp. 4–5.)

V. "Defendant denies that she is now infringing, or has at any time infringed, the said alleged improvement, or any part or parts thereof, as in said bill alleged, or that she has done, or intended to do, anything to disturb the possession, use, and enjoyment of the alleged exclusive privileges secured by the said reissued letters-patent, and the receipt of the profits of the same, as in said bill alleged." (p. 6.)

VI. Defendant admits Dunbar suit, but charges that said suit "was not in any fair sense an adversary suit or proceeding, and that the statements in the bill of complaint in the fourth paragraph thereof as to the same are incorrect, misleading, and untrue; that it is true such a suit was commenced, and that some evidence was taken therein on the part of the complainant, but there was *no proper defense* to said suit, no testimony taken on behalf of the defendants, and no cross-examination of the complainant, the principal witness in the case; that no service was made on one of the defendants; that no answer was ever filed by him; that a decree was entered against all the defendants, notwithstanding such want of service,

and the case was referred to a master for an account of profits and damages, and an injunction ordered to issue; but, so far as these defendants have been able to ascertain, no such writ of injunction was ever granted, and no further proceedings ever had before the master, and no final decree was ever entered in the suit. This defendant further says that she was not party or privy to said suit, and that she is not bound or concluded by the decision therein." (p. 6.)

VII. "This defendant denies that she is now constructing or using any blast furnace, in some parts thereof, or any part thereof, which is substantially the same in construction and operation as in the said reissued letters-patent mentioned, the exclusive right and privilege to make and use which, and vend the same to others to be used, is by law vested in said complainant." (p. 6.)

VIII. "This defendant denies that she has violated any rights of complainant, or has made and use, or intended to make and use, the said alleged several improvements, or any or either of them, within the Eastern District of Pennsylvania, or elsewhere; or that she has done, or intended to do, anything in violation of said reissued letters-patent, or of the alleged exclusive rights and privileges of said complainant thereunder, or by virtue thereof." (p. 6.)

IX. "Shortly after the above-mentioned decree in the suit of the Dunbar Furnace Co., complainant alleged that this defendant and her associates were infringing the said Lurmann patent, and called attention to said suit; that they replied, denying said infringement, or any intention of infringement, and requested to be informed in what the infringement consisted; that complainant replied, reiterating the charge of infringement, but without specifying wherein it consisted. Upon their refusal to listen to his demands, without knowing specifically what they were, complainant's attorney wrote speci-

fying the alleged ground of infringement, referring to the Dunbar suit, and suggesting a settlement; that upon the advice of counsel, after full investigation, they declined to recognize said complainant's alleged rights; and that for more than three years they heard nothing more of complainant's alleged rights, during all of which time their furnaces were in operation with the full knowledge and acquiescence of said complainant." (p. 7.)

X. "The interrogatories contained in the 7th paragraph of the bill of complaint have all been hereinbefore specifically answered. As an additional answer to the 3d section thereof, defendant denies that she has at any time made, used, or sold blast furnaces constructed, in whole or in part, upon the principles and in the manner described in said reissued letters-patent No. 3,204, the only furnaces used by her being constructed in substantial accordance with letters-patent No. 209,119, granted October 22, 1876, to Henry C. Grittenger, the manager of this defendant and her associates' works at Cornwall, Pennsylvania, with the exception of the omission of the water-cooling pipe in the weight-plate and around the slag-discharge opening, the use of such water-pipe having been for some time discontinued, this defendant not using any water-cooled arrangement to regulate or control the flow of slag through the furnace." (p. 7.)

XI. "This defendant denies that the said reissued letters-patent No. 3,204, dated November 24, 1868, is valid, but, on the contrary, alleges that it is invalid and void for the following reasons, to wit:

"1. Because said reissue application was never assented to, signed, or sworn to by the inventor." (p. 7.)

"2. Because it is for an invention different from that claimed in the original patent." (p. 7.)

"3. Because the said reissue contains much new matter interpolated by the assignee." (p. 7.)

"4. Because the specification of said reissued letters-

patent is not sufficient to enable any person skilled in the art or science to which the alleged invention appertains to make, construct, and use the same with practical success." (p. 7.)

"5. Because the alleged improvements attempted to be patented in said letters-patent did not involve or require invention, and did not differ in any patentable respect from what was before said alleged invention known and used in this country, or described in patents and printed publications." (p. 7.)

"6. Because there is no patentable combination between the elements constituting the first claim of said reissued letters-patent, and because no invention was required to produce the same." (pp. 7, 8.)

"7. Because the specification of said reissue letters-patent does not sufficiently describe the method of controlling the discharge of slag from blast furnaces by regulating the temperature of the slag-discharge piece, as claimed in the 7th claim of said reissue, to enable persons skilled in the art or science to which it appertains, or with which it is most nearly connected, to practice the same; that said method did not involve or require invention, and did not differ in any patentable respect from what was before said alleged invention known and used in this country, or described in patents and printed publications." (p. 8.)

"8. Because the 7th claim of the said reissued letters-patent No. 3,204 is void if construed to cover all methods of controlling the discharge of slag from blast furnaces by regulating the temperature of the slag-discharge piece; because it is not for an art, machine, or manufacture, or composition of matter, or for any improvement on either."

"9. Because the apparatus or alleged invention described, shown, and contained in said patent is not a patentable invention, but is inoperative and incapable of being applied to practical use without the further exercise of inventive skill or experiment." (p. 8.)

"10. Because the said F. W. Lurmann was not the original or first inventor or discoverer of the thing patented in said reissued letters-patent No. 3,204, or of any substantial or material part thereof; but that long prior to said alleged invention or discovery by the said Lurmann the thing so patented, or a substantial and material part thereof, or substantial and material parts thereof, claimed as new in said reissued letters-patent No. 3,204, had been invented or discovered and used in public by and known to numerous persons whose names and residence and the localities of whose prior use are now unknown to these defendants, but which, when known, these defendants pray leave, by proper amendment, to insert in their answer." (p. 8.)

"11. Because the things patented in and by said reissue letters-patent No. 3,204, or a substantial and material part, or substantial and material parts thereof, claimed therein as new, had long prior to the alleged invention thereof by said Lurmann been patented or described or contained in letters-patent numbered and dated and issued as follows, to wit:

"U. S. letters-patent No. 1,057, granted to I. C. Bryant for Blast Furnace, December 31, 1836.

"U. S. letters-patent No. 38,513, granted to Stileman & Ellis for Cupola Furnace, May 12, 1863.

"British letters-patent No. 1,000, granted to Daniel Dalton for Furnace, dated May 4, 1855.

"British letters-patent No. 1,470, granted to George Bedson, June 12, 1863.

"French letters-patent No. 12,383, granted to ——— Merle, July 27, 1854." (p. 8.)

"12. Because the things patented in and by said reissue letters-patent No. 3,204, or a substantial and material part thereof, or substantial and material parts thereof, claimed therein as new, had long prior to the alleged invention thereof by said Lurmann been fully described, contained, and set forth in the following printed works and publications, to wit:

"Kerl's Metallurgy, Vol 1, pages 157, 158, Plate II, Fig. 33, the title of which is as follows: 'Handbuch der Metallurgischen Hüttenkunde zum Gebrauche bei Vorlesungen und zum Selbstsudium. Bearbeitet von Bruno Kerl, Könige, Hannor, Hüttenmeister und Lehrer der Hüttenkunde und Probirkunst an der Könige, Bergschule zu Clausthal. In drei Bänden. Erster Band, mit litographirten Tafelen. Freiberg: Vorlag von J. G. Engelhardt, 1855.'

"Percy's Metallurgy, pages 354, 356, 357, Figs. 29, 32, 44, the full title of which work is as follows: 'Metallurgy: The Art of Extracting Metals from their Ores, and adapting them to various purposes of Manufacture. By John Percy, M. D., F. R. S., Lecturer on Metallurgy at the Royal School of Mines. Iron and Steel, with illustrations, chiefly from drawings carefully laid down to scale. London: John Murray, Albermarle Street, 1864.'

"Also in sundry other patents and publications, the grantees and names and dates of which are now unknown to this defendant, but which when known this defendant prays leave by proper amendment to insert in this answer." (p. 8.)

"13. Because, in view of the state of the art at the time of the alleged invention by said Lurmann, the claims of said reissued letters-patent are too broad, covering inventions before made by others, and of which he was not and his assignee is not entitled to the exclusive use and enjoyment." (p. 8.)

"14. Because, if said Lurmann or his assignee ever had a right to a patent for the alleged improvement specified in reissued letters-patent No. 3,204, or the right to have the same secured by letters-patent, he abandoned and forfeited the same, and lost all such right by his delay in applying for letters-patent therefor, and the same were put into public use and on sale in this country more than two years before his application for a patent thereon." (p. 8.)

XII. "And this defendant further answering denies the equity of said complainant's bill as prayed for in said bill of complainant." (p. 8.)

The Subject-Matter of this Suit.

A blast furnace or smelting furnace is a well-known structure, or apparatus, consisting, in effect, of a chimney, usually of cylindrical, or slightly conical external form, and of irregular, internal outline, usually that of two cones placed one upon the other, with their larger ends abutting, the lower one being the shorter of the two, and constituting the crucible or hearth in which most of the actual smelting is done. This crucible or lower part of the furnace is provided with two lateral openings at different levels, through the lower one of which openings the melted metal is allowed to escape at proper times, while the slag or scoriæ, and other effete matters, are in like manner discharged through the upper opening. Air is blown into this crucible, or hearth, through a series of blast-pipes, or tuyeres, arranged radically around the furnace, and extending through its walls above the point at which the actual fusion of the charge usually occurs.

The operation of such a furnace is clearly set forth in the opinion of this court in Vinton *v.* Hamilton, 104 U. S. 485, 487, 488, in the following words:

"It is a matter of general knowledge that pig iron is made from iron ore in a blast, or smelting furnace; that to secure this product the furnace is charged, first, with a layer of coke, or charcoal, then with a layer of iron ore, mixed with broken limestone, and so on in alternate layers until the proper quantity of these materials is placed in the furnace. The fuel is then ignited, and, for the purpose of increasing the heat, streams of air are forced into the furnace by means of blast-pipes, the nozzles of which, called tuyeres, are inserted in openings in the walls of the furnace, usually from four to six feet above its bottom.

"The limestone is used merely as a flux. The ore under this process undergoes a chemical change, and iron is formed and sinks in a molten state to the bottom of the hearth, by which is meant not only the bottom of the furnace, but its sides as high up as the foot of the boshes. The refuse left after the melted iron has dropped into the hearth is also in a molten state, and, being lighter than the iron, floats on its top. This is indifferently called '*cinder*' and '*slag*.' About three or four times in every twenty-four hours the melted iron is drawn from the furnace. This is accomplished in the following manner: The furnace is constructed with *two holes*, one called the iron and the other the cinder notch. The iron notch is made at the bottom of the hearth. The cinder notch is higher up the side of the furnace, just below the level of the tuyeres; so high that the cinder can be drawn through it without letting off the molten iron. These holes are kept habitually closed with clay, or other similar material. At frequent intervals, and always just before drawing off the molten iron, or making a cast, as the ironmongers call it, the cinder notch is opened, and the cinder, or slag, is allowed to escape, and is carried away from the furnace in a trough made of moistened sand. The cinder notch is then closed and the iron notch is opened, and the molten iron is drawn off through a sand-trough, and conducted into molds made in sand beds, called the sow and the pigs, where it is allowed to cool. The result is the pig iron of commerce.

"In the meantime the furnace is supplied with constant charges of fuel and ore, mixed with limestone, in alternate layers, dumped in from the top; and this process is kept up without cessation for months and sometimes for years."

A cupola furnace is an upright shaft furnace, usually of a cylindrical form, of less diameter and height and more slightly built than the old-fashioned smelting furnace. It is chiefly used for remelting cast iron for foundry purposes. It is thus described in the case above quoted, (104 U. S. 488:)

"A cupola furnace is one used for melting pig iron for the purpose of casting it into useful forms and articles. It constitutes part of the equipment of a foundry. In

shape it is generally a hollow cylinder. The iron is melted by substantially the same process as the ore in a blast furnace. The cupola furnace has an iron notch but no cinder notch, because there is generally so little cinder or slag in pig iron as to render such an opening unnecessary."

The old-fashioned smelting furnaces were of comparatively small size, used a weak blast, and were consequently capable of a small daily output.

The "cupola blast furnace," the modern form of blast furnace, resembles the cupola furnace used for foundry purposes in being made less massive in construction than the old-fashioned blast furnace, but at the same time of much greater size, the largest being over a hundred feet in height and twenty-five feet in diameter across the boshes.

(See Century Dictionary, articles "Blast Furnace," "Cupola Furnace," "Furnace," and "Smelting Furnace.")

It will thus be seen that blast furnaces and cupola furnaces are essentially the same in structure, organization, and operation, with certain modifications adapting each to its special work.

The essential question here to be considered is the novelty and patentability of a *water-cooled slag-discharge opening in a close-breasted blast furnace.* What these terms mean will be hereinafter fully explained. We will first consider these elements separately.

The Prior State of the Art.

Separate Iron and Slag-Discharge Openings.

These are shown in the following exhibits of defendant, viz:

Stileman & Ellis patent of 1863. (p. 114.)
Dalton's British patent of 1855. (p. 109.)
Extract from Percy's Metallurgy, 1864. (p. 105.)
Extract from Kerl's Metallurgy, 1855. (p. 104.)

The Lurmann reissue recognizes the fact that both a cinder-notch or slag-discharge opening and an iron-notch

or iron-discharge opening were old in the art at the time of his invention. (p. 47, folio 80.)

See also the Karsten Furnace, Keyes *v.* Grant, 118 U. S. 32, 33.

WATER-COOLING.

Bryant's U. S. patent No. 1,057, of December 31, 1838, (Defendant's Exhibit Bryant Patent,) states, among other things:

"Fifth. I cool the crucible of the furnace and prevent its burning rapidly away by placing around it several metallic boxes or cases filled with water, the water entering at an aperture in the lower portion of each box and passing out at the upper portion, so as to keep up a constant current, and thus absorb a portion of the heat from the crucible."

"Figs. 5 and 6 are different views of one of the water-tuyeres, showing in Fig. 5 where the blast enters the tuyere, and in Fig. 6 the opening whence it escapes to the furnace. Z, Fig. 5, and Z, Fig. 6, are two of the cases or boxes containing water placed over the tuyeres and around the crucible to cool the latter by a current of water passing through them and absorbing a portion of heat."

Claim—

"5. The use of *boxes* or cases containing water constantly shifted by a current placed around the crucible, so as to absorb a portion of its heat and increase its durability. These boxes may be made in number and breadth only equal to the water-tuyeres, or they may be increased either in number or in breadth, so as to form an entire circle around the crucible. Their size and thickness may be varied as experience may prove to be expedient. They may be extended in height from the bottom of the crucible to the top of the square of the crucible."

Defendant's expert Brevoort (Ans. 16, p. 7) says:

"A. Referring first to the Bryant patent, I find there shown a blast furnace, which has around the crucible of the furnace water-casings, which are to absorb the heat and thereby increase the durability of the crucible. These water-jackets are to have fresh water constantly flowing into them, so that they are kept cool. The specification

of this patent is divided into various heads, which are numbered; and I call attention to the fifth head, which fully describes the extended water-jackets. This description in the Bryant patent fully, in my judgment, shows the invention of the sixth claim of the Asmus reissue. It describes his plates, which are the same as the plate C, and they are described as cooled by currents of water which circulate in them. Figs. 5 and 6 show the water-jackets as used in connection with the tuyeres.

"Defendant's 'Exhibit Percy' describes a blast furnace and a tymp which is water-cooled. I quote from the description accompanying the drawing:

"'Immediately under this arch is fixed the tymp itself, which is a long rectangular casting of iron containing in its interior a wrought-iron tube through which cold water is kept circulating.' (See Figures 47, 48 and 49.)

"Then follows a description of how to make a tymp of this description which it is unnecessary to quote. Turning to the drawings which accompany the description, I find the *water-cooled plate* or tymp fully shown, with the water-circulating pipes cast therein. The tymp is of a shape slightly different from the tymp of the Asmus reissue, but this fact is, I should think, immaterial, for the tymp used in defendant's furnace, and which is said to be the equivalent of Asmus plate C, is of an entirely different shape from that plate. I think that defendant's 'Exhibit Percy' shows the entire invention contained in the sixth claim of the Asmus reissue. The plate is the same plate used in the same part of the furnace, and water-cooled in the same way as the tymp of Asmus marked C, or the tymp used in the defendant's furnace.

"Referring next to Defendant's 'Exhibit Open Hearth,' I find that this exhibit has a tymp substantially identical with that used by the defendant, and which form of tymp is, I believe, exceedingly old and well known. All these old tymp plates were water-cooled, and were used exactly as Asmus uses his tymp plate which he calls C in his patent. I am therefore of the opinion that defendant's 'Exhibit Open Hearth' clearly shows the entire invention of the sixth claim of the Asmus reissue."

Campbell (Ans. 4 and 5, p. 60) says:

"Q. 4. Please look at section model now shown you, 'Exhibit Open Hearth,' and state whether it is or is not

a fair representation of an old furnace having an open hearth?

"A. It is.

"Q. 5. For how long have you been acquainted with such style of furnaces?

"A. I have been acquainted with such furnaces since 1858."

Asmus, (Ans. 7, p. 12, fol. 27,) referring to Complainant's Exhibit Sketch No. 2, admits that "a tymp plate E [B], often cooled with water, was in use long ago with such furnaces, but the cinder was not tapped directly from the hearth. It was taken out through the fore-hearth, F."

"Q. 26. Please look at 'Defendant's Exhibit Model Open Hearth,' and state if water-cooled tymps, such as are there shown, were or not known and used before the year 1865?

"A. They were." (Grittinger, Ans. 26, p. 60.)

These references abundantly show that long prior to the date of Lurmann's alleged invention the cooling of the various parts of the furnace exposed to the action of heat and the friction of the outflowing cinder or slag was affected by a regulated water circulation.

SLAG–DISCHARGE THROUGH WATER–COOLED TUYERE.

Brevoort (p. 73):

"Q. 9. Please state whether or not you understand that Lurmann was the first to suggest the possibility of removing the slag through comparatively small opening.

"A. He was not. Everybody knew that comparatively a small opening would serve to remove the slag through. Indeed, the opening in an old open-front furnace was comparatively small, approximating to the size of the Lurmann opening.

"Referring to the English patent of Dalton, No. 1,000, of 1855, I find a smelting furnace shown, in which the iron is drawn from a hole in the furnace near the bottom, while the slag is tapped through a hole above. This furnace has no open fore-hearth. The patent shows that the broad idea of removing the slag through a small hole in a

furnace, without a fore-hearth, was not new with Lurmann. It is true that the Dalton furnace differs in shape and somewhat in mode of operation from Lurmann's furnace; but, so far as the tapping of slag goes, there is no material difference in that; both take the slag out through a small hole in a furnace which has no fore-hearth."

Campbell (p. 62):

"Q. 25. Can you state whether any other expedients than drilling through the fore-hearth were resorted to before 1865 for getting rid of the slag in a furnace, the breast of which was closed?

"A. We tapped cinder *through*, beneath, and between the tuyeres. *This before* 1865.

"Q. 26. Can you state where you so tapped cinder through the *tuyeres?*

"A. At James Wood & Co.'s, Middletown.

"Q. 27. How often did you do that?

"A. Frequently.

"Q. 28. Were those tuyeres *water-cooled* or not?

"A. Yes; at the time we used the shell tuyeres.

"Q. 29. How long would you thus discharge cinder through a tuyere?

"A. Every hour; say for twenty-four hours at a time. Sometimes as long as a week.

"Q. 30. What was the practice before 1865 as to water-cooling the various parts of the furnace?

"A. We cooled the front or dam, the tymp, and sides with water running through.

"Q. 31. How was the flow of cooling water controlled?

"A. By stop-cocks on pipes.

"Q. 32. What was the object of cooling the parts?

"A. To preserve the tymp, dam, and sides.

"Q. 13. It has been stated by one of the witnesses called on the part of the defendant that it was his practice, when the fore-hearth was stopped up, to flush his cinder through one of the tuyeres. You have read the testimony, I believe; if so, please compare this method of operating a furnace with the first claim of the Asmus reissue, and state what similarity or dissimilarity you find. The witness I refer to is David Campbell.

"A. Yes, I heard the testimony of Campbell taken in this case, and I understand what he describes concerning the use of one of the tuyeres of the furnace for discharg-

ing the slag. Of course, if the aperture cooled by water of the first claim of the Asmus reissue is any aperture, then the old use described by Campbell would show the invention, for at the time he used the tuyere the furnace had practically a closed breast, and the slag was discharged through an aperture cooled by water, but in this case, as in the case of the defendants, the water could have exercised no control over the slag discharged, and consequently I am of the opinion that such old use by Campbell did not show the Asmus invention, as I understand that invention, for it is necessary to the Asmus invention that the aperture cooled by water should be of such a form, and the water should be so applied, that control of the stream of slag can be obtained by means of the flow of water in the channels or cavities of the block through which the slag flows out." (Brevoort, Ans. 13, pp. 75–76.)

DISCHARGE DIRECT FROM HEARTH THROUGH CLOSED BREAST.

"Q. Was it not the practice for many years prior to 1867 to tap melted irom directly from the hearth of the furnace?

"A. In some places they did tap directly from the furnace—but it was iron." (Hahn, X. 51, p. 43.)

It is not pretended that any of these references show the precise construction claimed by Asmus as Lurmann's assignee; they are introduced for the purpose of demonstrating that, in view of the prior state of the art, his claims must be limited to his specific organization, which we do not infringe, and that any attempt to construe them broadly, as is sought to be done by appellee, would necessarily render then void for want of patentability, as well as of patentable novelty, in view of repeated decisions of the Supreme Court of the United States.

Vinton *v.* Hamilton, 104 U. S. 485.

Atlantic Works *v.* Brady, 107 U. S. 192.

Penn. R. R. Co. *v.* Locomotive Safety Truck Co., 110 U. S. 490, and cases cited.

Stephenson *v.* Brooklyn Cross Town R. R. Co., 114 U. S. 149, and cases cited.

Thatcher Heating Co. *v.* Burtis, 121 U. S. 286, and cases cited.

Hendy *v.* Golden State Works, 127 U. S. 588, 594, and cases cited.

St. Germain *v.* Brunswick, 135 U. S. 227.

Fond Du Lac Co. *v.* May, 137 U. S. 395, 406, 407, and cases cited.

McLain *v.* Ortmayer, 141 U. S. 419.

Lurmann's Invention as Described in his Original Patent. (pp. 82-85.)

"This *invention relates to furnaces for smelting iron ore*, and has for *its object to dispense with the 'tymp' or fore-hearth and the 'wall-stone' now in common use in iron-blast furnaces, and to replace the tymp arrangement by such a construction as allows the slag to be tapped directly from the hearth.*

"In the tymp arrangement the slag is driven out of the furnace by being first forced below the tymp-stone, which projects below the level of the tuyeres and intercepts the currents of air, and prevents their escape with the slag, which stands in the tymp at the same level as on the hearth, the slag being discharged only when it rises in the tymp high enough to overflow the top of the wall-stone that forms the bottom of the discharging orifice. By this arrangement the tymp-stone constitutes a trap which intercepts the currents of air, and causes their pressure to be exerted directly on the surface of the slag on the hearth.

"This method of construction has several disadvantages, one of which is the difficulty of keeping the tymp-stone and the surrounding parts in repair; another is, that the pressure of the currents of air or wind is limited and counteracted by the counter-pressure of the column of slag in the tymp; and another is, that one side of the furnace being occupied by the tymp, no tuyere can be applied on that side, and consequently the supply of wind is irregularly distributed.

"My invention avoids or overcomes these disadvantages in a simple and effective manner.

"In this example of my invention the letter A designates the furnace, and B several tuyeres, which are arranged therein at a proper height. My furnace has no tymp, and the sides of the hearth, whether round or

square, extend clear down to the bottom-stone, *the usual opening (not shown in the drawing)* being made in the lower part of the hearth, for the discharge of the iron. The openings or the tuyeres B are distributed at equal distances apart in the sides of the hearth. At a suitable height from the bottom-stone I leave an opening in the hearth, in which I place a cast-iron or brass slag-discharge piece, D, which is cast or made with numerous channels or pipes, running up and down or in other directions through it, as shown in figs. 3 and 4. The piece D is formed with a dovetail on its upper end, which is fitted into the bottom of *a stationary metallic plate C, connected with the furnace. This plate is also cast or made with channels or pipes running through it*, and the channels or pipes of said plate and of the piece D may be so arranged as to connect or or communicate with each other when the plate C and piece D are in their proper positions, or they may be independent of each other. *The object of the said channels or pipes is to permit the plate C and piece D to be cooled*, by forcing water through them while the furnace is in operation, proper connections being made for that purpose with a reservoir of cold water, or with a force-pump. *One or more holes are made in said piece D, through which the slag is discharged, the shape of said holes being shown in figs. 3 and 4, the middle portion being cylindrical, but each end being conical or flaring.*

"The dimensions of the slag-discharge piece are a little less than the opening in which is placed, and the space left around it is filled with sand, which can be readily removed in case it is desired to remove the piece D to repair it, or if it is desired to have an opening in the hearth to work through, as when any iregularity in the smelting process has taken place. *The flow of cooling water through the slag-discharge piece D is regulated for the purpose of controlling the discharge of the slag through it.* By allowing much cooling water to circulate through its water-channels or pipes, *the temperature of the piece D is lowered sufficiently to allow a coating of slag to adhere and choke its discharge openings, which are of less diameter in the middle than at their ends.* By reducing the flow of cooling water the piece is allowed to retain a higher temperature, and in consequence the slag is melted out of the discharge-openings, and they become clear and open, and permit the slag to flow without interruption. When the slag in the

hearth is lower than the level of the discharge-openings, the latter are simply closed by an iron rod."

From this description it is apparent that Lurmann understood his invention to consist essentially of a removable slag-discharge piece cast with numerous channels or pipes running through it, formed with a dovetail at its upper end fitted into the bottom of a stationary metallic plate connected with a furnace, and provided with channels or pipes so that water might flow through the slag-discharge piece and plate conjointly or separately, that they might be cooled while the furnace is in operation. The slag-discharge piece was made removable and provided with one or more holes, the middle portion being cylindrical but each end being conical or flaring. By regulating the flow of water through the slag-discharge piece its temperature could be lowered sufficiently to allow a coating of slag to choke the discharge opening, which could be melted out by diminishing the flow of water and raising the temperature. This opening could be closed by an iron plug when necessary.

The fundamental devices claimed by Lurmann as his improvements were these:

The metal *plate C provided with water channels;*

The removable *slag-discharge piece provided with water channels*; and

The method of regulating the discharge of the slag by raising and lowering the temperature of the slag-discharge piece.

The claims, six in number, may be epitomized as follows:

"1. *The slag-discharge piece D constructed and arranged* substantially as described."

This, by any fair rule of interpretation, must mean a slag-discharge piece provided with a water circulation connected with a water-cooled plate C, and having small hour-glass-shaped discharge opening, and capable of being removed from the furnace when desired.

"2. The *slag-discharge* piece D, in combination with the *water cooled plate C.*"

This, being the same slag-discharge piece as that described in the first claim, must have the same capacities and functions; that is to say, it must be removable, provided with a water circulation, and have an hour-glass-shaped discharge opening of small area to regulate the flow of the slag. (Hendy *v.* Golden State Iron Works, 127 U. S. 588, 594.)

Claim 3 is for the *shape of the slag-discharge opening* D, flaring at its end, and of diminished diameter in the middle.

The fourth claim is for combining the *slag-discharge piece* and its *water channels* or pipes.

The fifth claim is for combining *similar pipes* with the *metallic plate C.*

The sixth claim is for "The method of *controlling* the *discharge of slag from blast furnaces, by regulating the temperature of the slag-discharge piece,* substantially as described."

This undoubtedly was meant by Lurmann to be his principal claim. The method described was undoubtedly that of regulating the slag-discharge by varying the temperature of the water-cooled block, and for nothing else.

The Reissue.

These claims were not, however, comprehensive enough to suit the assignee, who thereupon proceeded to obtain a reissue. (Exhibit Complainant's Patent. pp. 46–49.)

In regard to this reissue, Asmus says (p. 28):

"Int. 75. What was your reason for applying for and obtaining a reissue of this patent?

"A. To make the meaning of the whole invention as clear as possible to all who were concerned.

"Int. 77. State why you did not apply for a reissue sooner than you did?

"A. In arranging a number of furnaces I found that the same differed more or less in the construction, and I

had to adapt my construction according to the circumstances. This made it necessary to give the construction quite different shapes so the main points always remain the same. This experience caused me, in order to prevent mistakes, to find a formula which expresses the spirit of the invention in the clearest way possible, and which flows plainly from the technical description given in the original patent. The experience and the reasoning deriving from it took up some time."

This statement shows that the reissue was not obtained promptly to remedy formal defects apparent on the face of the papers, but that the assignee waited until experience and reasoning showed him the broadest formula in which to express his patent so as to cover all possible modifications.

"Int. 78. Did you know that you were entitled to apply for a reissue of the patent?

"A. I learned so through my patent lawyers, Van Sanvoord and Hauff, in New York. I learned this about a year after the first patent was taken out. (p. 28.)

"X-int. 97. What kind of mistakes did you expect to prevent by finding a formula to express the spirit of the Lurmann invention, as stated in your answer 77?

"A. That difference in shape might be taken for a different thing." (p. 31.)

These excuses, made under the stress of the numerous recent decisions of the Supreme Court in regard to reissues, do not quite tally with the statements made by Asmus himself and by his attorneys in seeking the reissue.

In his petition for the reissue (p. 89) Asmus alleged Lurmann's patent to be inoperative and invalid by reason of a defective specification; yet, as will be seen by the comparison of the original with the reissue specification printed in defendant's record, page 56, he made no substantial change in said specification, except to insert enlarged definitions and descriptions of the alleged invention and one new and enlarged claim.

In the oath accompanying his reissue application (p. 89) he did not swear the specification to be inoperative and invalid, but only that "the *aforesaid patent is not fully valid and available to him;*" the "*availability*" doubtless being the true reason for the reissue.

The statement made to the Patent Office relative to the occasion for the reissue is as follows (pp. 89–90):

"Statement.

"Relating to the application of George Asmus for the reisssue of letters-patent granted to F. W. Lurmann, for an improvement in Blast Furnaces, No. 70,477, dated Nov. 5, 1867.

"The errors and defects occurring in the original specification by inadvertence and mistake and sought to be corrected by this application for a reissue, are as follows:

"The invention, as described in the original specification and represented in the drawings, clearly comprises a blast furnace with a closed breast, where the slag is discharged through an opening or openings cooled with water, but the *claim in the original specification is confined to a slag-discharge piece or cinder-block constructed and attached in a certain specific manner.* It is obvious that the cinder-block D can be connected to or cast solid with the plate C without changing the nature of the invention, and in the new specification this defect has been corrected and a *clause has been added to the claim with a view to cover the whole ground of the invention.*"

This statement contains a distinct admission that the original claim was confined to *a slag-discharge piece constructed and attached in a certain specific manner.* We shall hereafter see what the clause added to the claim "with a view to cover the whole ground of the invention" really was.

Exhibit Assignment (p. 87) from Lurmann to Asmus recites:

"Whereas I, Fr. W. Lurmann, of Osnabruck, in the Kingdom of Prussia, Germany, am about to make application for letters-patent of the United States for a new and useful improvement in blast furnaces, *which invention is*

fully described in the specification pertaining to said application, which I have signed under oath."

Notwithstanding this explicit statement on the part of the inventor, that his specification fully described his invention, his assignee—nearly twelve months after the grant of the original patent—comes in with an enlarged specification and claims, covering an invention broader and different from that originally claimed by the inventor himself.

The reissue application was never sworn to by the inventor, and his consent thereto was never obtained. We are aware that, as the law stood at that time, the assignee had a legal right to obtain a proper reissue without the inventor's oath, and that after the grant of the reissue even the omission of any oath at all would probably have not invalidated the reissue. That is not our point. We cite the failure of the inventor to assent to the application simply to show that the enlargement of the invention sought to be made by the reissue was done by an assignee, and not by the inventor; and it behooves an assignee under such circumstances to be very accurate and careful in defining the invention; not to enlarge its scope beyond what was claimed in the original. The assignee might very well claim matter which the inventor knew to be old, and could not swear to, although set out in his specification; and his failure to claim it originally raises a very strong presumption that he knew it to be old.

The Invention as Enlarged by the Reissue.

The original and reissue specifications are printed together for comparison. (pp. 78–87.) The parts in italics are not in the original, and the parts in brackets are omitted from the reissue.

The original states (p. 78):

"This invention relates to [furnaces for smelting iron ore, and has for its object to dispense with the 'tymp' or fore-hearth and the 'wall-stone' now in common use in

iron-blast furnaces, and to replace the tymp arrangement by such a construction as allows to slag to]"

All after "relates to" is stricken out in the reissue, and the following inserted (p. 79):

"*certain improvements in blast furnaces with a closed breast; and it consists, principally, in a blast furnace with a closed breast, where the slag is discharged through an opening cooled with water in such a manner that the tymp or fore-hearth and the wall-stone can be dispensed with, and that the slag can* be tapped directly from the hearth.

"*It consists, further, in a slag-discharge piece or 'cinder-block' of peculiar construction, as will be hereafter more fully explained, whereby the building of a furnace according to this invention, and its correct operation, are materially facilitated.*

"*In order to enable those skilled in the art to fully understand the object of this invention, I will first point out the disadvantages of blast furnaces with a fore-hearth, such as are now in common use for melting iron ore.*"

This is a new and broad definition on which to base the 1st claim of the reissue, *which was not in the original*, and *is the only claim upon which defendant* is held liable, and makes the invention to consist in a *blast furnace with a closed breast where the slag is discharged through an opening cooled by water.*

The reissue specification (p. 79) then proceeds to point out the disadvantages of blast furnaces "such as are *now* in common use for melting iron ore"—that is, at the date of the application for the reissue. The slag-discharge piece is converted into a "cinder-block." In addition to the description in the original, of its connection with the metallic plate C, is added, (p. 80,) "*or it may be attached to said plate in any other desirable manner, or cast solid with the same, if desired.*"

This is an entirely new suggestion, without a word in the original to justify it. But this is not quite enough to satisfy the assignee, who adds (p. 80):

"*In the drawing the plate C is shown above the cinder-block, but it may be also placed below, or in any other desirable position in relation to the same.*"

This is also a suggestion not warranted by the original patent.

Again, the reissue says (p. 80):

"*This* invention can be easily applied by those skilled in the art to which it belongs to blast furnaces of the common construction *by removing the fore-hearth and closing the aperture left in the breast of the furnace under the tymp-stone, by inserting the plate C with the cinder-block D.*"

This suggestion of removing the fore-hearth, etc., is not only entirely new matter, but is utterly misleading and untrue.

Brevoort (Ans. 18, p. 78) says:

"Q. 18. I call your attention to the following paragraph in the Asmus reissue:

"'This invention can be easily applied, by those skilled in the art to which it belongs, to blast furnaces of the common construction by removing the fore-hearth and closing the aperture left in the breast of the furnace under the tymp-stone by inserting the plate C with the cinder-block D.'

"What do you say as to the correctness of this statement?

"A. I think that this statement is utterly untrue. If it was attempted to be put in practice the slag-block would be where the iron notch should be, and slag could not be drawn at all. In the drawings of the Asmus reissue the reverse of this statement is there shown. The plate C is placed against the tymp-arch and not below the tymp-stone."

This charge remains unanswered by complainant.

The culminating point of the reissue, however, is the 1st claim, which is entirely new matter, and which comprehends the alleged infringement. This first claim is for "*a blast furnace with a closed breast where the slag-discharge is cooled by an opening or openings cooled by water,* substantially as set forth." The "substantially as set forth" probably refers to the definition of invention, which means "through an opening cooled with water in such a manner that the tymp or fore-hearth and the wall-stone

can be dispensed with, and that the slag can be tapped directly from the hearth."

The decisions of the Supreme Court have given no uncertain sound of late years as to how such reissues as this are regarded in the eye of the law, and they are so familiar to the court that citation is almost superfluous.

The doctrine as to expanded and enlarged reissues was announced in Burr *v.* Duryee, 1 Wall. 531; Miller *v.* Bridgeport Brass Co., 104 U. S. 350; Heald *v.* Rice, 104 U. S. 737; Mahn *v.* Harwood, 112 U. S. 354, and Coon *v.* Wilson, 113 U. S. 268, and again approved in Woolensak *v.* Reiher, 115 U. S. 96, and numerous other cases.

As was well said in Electric Gas Co. *v.* Boston Electric Co. 139 U. S. 481, 501: "The new claims of the reissue are not for the same invention set forth in the claims of the original."

The attention of the court will doubless be called to the fact that the reissue was applied for within less than a year of the actual grant of the original patent; but under circumstances similar to these, the courts have held that an application for reissue, even three months after the grant of the original patent, would not justify the grant of such a reissue as this.

Coon *v.* Wilson, 113 U. S. 268.

Lurmann's Invention as Expanded by Asmus.

Complainant manifestly construes the first claim of the Lurmann reissue to cover any kind of a closed breast furnace with any kind of a slag-discharge opening cooled in any manner or to any extent by water. Such a claim manifestly cannot be maintained, but that it is asserted to this extent is fully shown by the record.

Asmus himself says (pp. 12–18):

"Int. 6. What do you mean by the expression 'closed front' used in your third answer?

"A. A blast furnace where the cinder discharge takes place directly from the hearth and not through the me-

dium of a fore-hearth, the latter being an outside part of the hearth proper at furnaces which are technically called open front furnaces. (p. 12.)

"Int. 14. You have spoken about closed front furnaces; please state what construction, if any, of cinder discharge opening is used with such furnaces?

"A. In building the hearth an opening is left in the wall at the proper height, a foot or two below the tuyeres, through which the cinder is tapped directly from the hearth, and this opening is protected by water-cooled castings or water coils from being eaten away or enlarged. (p. 13.)

"Int. 15. What effect, if any, would be produced by the tapping of the cinder in the absence of this provision for protecting the opening?

"A. The brick work of that part of the hearth where the cinder is discharged would be melted away by the cinder flowing through an unprotected opening. (p. 13.)

"Int. 16. State whether or not a closed breast furnace without such provision for protecting the wall at the cinder opening would be a practically useful and operative furnace?

"A. Such a furnace would not be practicable for the reasons given before, especially where hot blast, high pressure, and lean ores come together, all tending in their effects to destroy such an unprotected opening.

"Int. 17. Referring now to the defendants' furnace as shown by 'Exhibit Asmus Sketch No. 1,' please state whether or not the construction is such to affect the protection of the wall at the cinder outlet which you have just described?

"A. It is. The cinder outlet C in the sketch is protected from three sides, it being made through the water-cooled plate A."

(Erroneous—See Grittinger, Ans. 14, p. 25.)

"Int. 18. How far does the cooling effect of a water-cooled casting of the kind used by the defendant at the cinder discharge opening of her furnace afford an efficient protection to adjacent parts of the wall?

"A. The cooling effect of water plates as they are usually made to protect brick work at the furnaces, practically to a distance of about six inches. It can be increased by the use of larger water pipes and higher water pressure, if desired.

"Int. 19. How large is the opening usually made through the clay stopper which is placed in the notch C of furnaces constructed like the defendant's when it is desired to tap the cinder?

"A. About an inch.

"X-int. 26. In 'Exhibit Sketch No. 2' you represent an open front or fore-hearth furnace; how far in front of the tymp-plate does such a fore-hearth usually extend?

"A. From two to four feet according to size of furnace.

"X-int. 27. As a matter of fact, are not furnaces frequently worked with a fore-hearth not greater than ten inches?

"A There are furnaces which are running that way, but I never saw one before I introduced Lurmann's construction in this country. A fore-hearth being only ten inches long, is in every technical sense of the word no fore-hearth any more. It is impossible to dig it out, and all those furnaces with such short distance between tymp and dam-plates tap the cinder directly from the hearth, and not from the lower part of the hearth under a stopper, which is, in fact, nothing but a downward prolongation of the tymp, constituting an intercepting trap between hearth and fore-hearth. The very word 'short neck' which is used for this imitation is younger than Lurmann's patent. (p. 17.)

"X-int. 28. At what point between ten inches and two feet, in your estimation, would a fore-hearth cease to be a fore-hearth?

"A. It would cease to be a fore-hearth where it is impossible and at the same time unnecessary to repair a stopper, because only a very short distance between tymp and dam-plates would make it possible to run the furnace without cleaning out the recess called fore-hearth. I think the minimum of this distance must be at least two feet. If the fore-hearth is long enough to enable the workmen to repair the stopper, it would be too long to allow running the furnace without cleaning out the fore-hearth, the dam-plate being too far away from the real heat of the hearth, and the masses filling that fore-part would chill, often making the iron tap difficult and in a great many cases impossible. Practice has shown that no recess at all is the best way, and a recess of ten inches is only an obstacle to the practical working of the furnace, it being a closed

front with a part of the old disease, and without its former intention. *The old fore-hearth was a necessity until it was found how the cinder could be run from a furnace without ruining that part of the wall, and this was by cooling it properly.*

"X-int. 29. Is that the best answer as to actual distances that you are able to give to the foregoing question?

"A. Practically speaking, a furnace ceases to have an open front where the horizontal distance between tymp and dam-plates is so much shortened that the tapping of the cinder straight from the hearth is possible and can be done constantly without the necessity of opening the front and cleaning it out. It is practically impossible to run a furnace on the open front system with a stopper or intercepting cinder-trap where the distance between tymp and dam is less than two feet.

"X-int. 30. Then practically speaking, I understand you to claim that a fore-hearth of less than twenty-four inches ceases to be a fore-hearth and becomes substantially a closed breast. Is that correct?

"A. Practically; yes. (p. 17.)

"X-int. 31. Your exhibit 'Sketch No. 2' shows a stopper G projecting below the tymp and below the top of the dam-plate. For the sake of clearness we will call the material closing the opening between this stopper and the wall D of the dam-plate the filling. Now, practically, how far below the top of the dam-plate does the stopper C of the blast furnace usually extend?

"A. About eighteen inches. They hold it as deep as they can, but it eats away.

"X-int. 32. With a downward projection of eighteen inches below the dam-plate on the part of the stopper and a distance of two feet between the adjacent walls of the two, at what angle would it be necessary to perforate the filling to secure the discharge of the cinder?

"A. At an angle of about forty degrees or something of that kind.

"X-int. 33. And this angle would increase as the fore-hearth is shortened, would it not?

"A. Yes.

"X-int. 34. Then, as I understand your construction of Lurmann's patent, the horizontality of the discharge opening for the cinder has no relation to the question of infringement?

"A. It is a direct cinder-trap from the hearth, omitting an intercepting trap formed by the stopper, which in fact constitutes the closed front; there being no stopper, it follows that the closed front is made by a horizontal thrust; the downward thrust, as it is done at an open-front hearth, is made in order to form a stopper and to prevent the cinder in the hearth to be thrown by the pressure of the blast into the casting-house.

"X-int. 35. Then, as I understand your last answer, it is the omission of the intercepting trap formed by the stopper which in fact constitutes the distinction between an open and a closed front furnace, is that correct?

"A. Yes; it is the absence of the intercepting trap and the fore-hearth, which both constitute the open front.

"X-int. 36. Then, as I understand it, your answers 8 to 12 inclusive, as to the relative advantages and disadvantages of the open and closed front furnaces, have been based upon the understanding developed in your X-answers 27 to 35 inclusive, is that correct?

"A. Yes." (p. 18.)

It clearly appears from answers 28 and 30 that Asmus regards any fore-hearth less than two feet long as an infringement of the Lurmann patent; while he admits that the well-known old-fashioned fore-hearth varied from two to four feet according to the size of the furnace. (See X-26 above quoted.)

Complainant likewise attempts to confound improvements subsequently made with those alleged and described in the patent; for instance, proof is offered as to the use by complainant's assignees of a water-cooled discharge opening, consisting of three separate conical cinder-blocks, one fitting within the other, and adapted to gradually enlarge the cinder-discharge opening by the successive removal of two of them. (See Complainant's Exhibit Kennedy, p. 90, and depositions of Porter, Ans. 15, p. 34, and Kennedy, Ans. 8, p. 19.) No such apparatus is shown, described, or suggested in Lurmann's patent.

Exhibit Asmus Paper, p. 116 gives complainant's views as to this alleged invention in 1875. He lays great stress upon a *bronze* cinder-discharge block, but no such block

is suggested in the patent. Both material and construction are an afterthought. The sole question here is what does the patent claim? not what an inventor or his assignee may afterwards discover.

The Coleman Furnace, said to contain the three-cone bronze cinder-block, (Asmus, Ans. 61, p. 25,) was only licensed about 1881. (Asmus, X-87, p. 30.) The Edgar Thomson Furnace was licensed in 1879. (Kennedy, X-28, p. 22.) When the other furnaces containing this feature were licensed does not appear, but it was probably some time after the issue of the patent.

What Lurmann's Assignee is Actually Entitled to Claim.

The fundamental idea of Lurmann's invention undoubtedly was to melt all foreign matters and discharge them continuously through a small opening, say an inch and a half or two inches in diameter, *cooled by water in such a manner as to control the discharge.*

Brevoort (pp. 70–72) says:

"Q. 6. State what you understand to be the mechanism described, and the operation of said mechanism as you understand it from examining Lurmann's original patent, and I call your attention specially to the first claim of the said patent.

"A. Lurmann's original patent, No. 70,447, relates to an improvement in blast furnaces. The improvement, as I understand it, consists in discharging the slag or cinder, and any impurities which may pass below the tuyeres as a liquid through what Lurmann calls 'a slag-discharge piece.' This consists of a block of metal having a small hole in it through which the liquid slag and other melted impurities are to be constantly drawn from the interior of the furnace. This block, however, would not last long or be serviceable were it merely a piece of iron with a hole in it. So Lurmann's invention went further than this, and he describes that the block is to be cooled with water, and so cooled that by passing water through the cavities of the block in large quantities the block can be so chilled that the cinder will be checked in its flow outward, and

that in this way the amount of liquid material discharged can be regulated by regulating the quantity of water used in connection with the block. The block is also to be removable, so that a large opening may be readily obtained from the outside to the inside of the furnace. These are the capacities which Lurmann's cinder-block are to possess.

"He describes, in his specification, that the furnace is to be without a fore-hearth or with a closed breast. Thus it is evident that it was his intention to reduce all foreign matters to a liquid, and pass them out constantly through the hole in his cinder-block. *Lurmann nowhere describes how large the opening in his block is to be*, but it is evident from the description that the opening is to be of such a size that water, when freely used in the cavities of the block, will cause the slag to congeal upon its surface to such an extent as to choke the discharge opening; that is to say, the water is to have the capacity of regulating the slag-discharge. Now, it is evident that to achieve this result, the opening must be one of small area, for, if it were not, the water could have no possible effect in regulating the slag-discharge.

"The common form of furnace before Lurmann's invention, and the form largely used up to the present time, had a fore-hearth or open breast, and this large opening into the furnace was usually closed by an iron plate and stopping-clay, or other material. When the slag was to be discharged, a small hole was made through the clay, and the slag passed out through it, but when the foreign matter that had passed the tuyeres had accumulated in the bottom of the furnace, the front was opened and such matter removed with picks, bars, and shovels. Mr. Lurmann proposed to shut up this fore-hearth, and melt all the foreign matter that passed the tuyeres, and pass it out through the small opening in his cinder-block as a liquid, the stream being under the control of the water in the cavities of his cinder-block.

"The first claim of his original patent is as follows:

"'1st. The slag-discharge piece D, constructed and arranged substantially as described.'

"From the foregoing it is clear what is here referred to. It is the block of metal having a small hole or holes in it, the opening being so small that water, when circulated in the cavities of the block, will control the discharge of

materials through such opening. The block, however, must have another feature, it must be readily removable, thus leaving a large opening to work through; it must be constructed and 'arranged' as described; and part of the necessary arrangement is that the block should be capable of being readily removed from the opening in the furnace which, when in use, it occupies. So far as the claim goes the conditions of the invention would be satisfied if this piece were used with a furnace having an open front, or, as it is more commonly called, a 'fore-hearth.' There is no limitation in the claim to the use of such a block, only in connection with a furnace having a closed front, and the closed front is nowhere mentioned in the claims.

"Q. 7. Please state what you understand to be the mechanism described in the first and second claims of the Asmus reissue No. 3,204, dated November 24, 1868?

"A. The reissue describes in the specification substantially the same thing as is described in the original patent, though it uses different terms. The drawings in the reissue are the same as the drawings in the original patent. The claims have, however, been altered. Referring to the second claim of the reissue, I find that it is the same in terms as the first claim of the original; consequently, I suppose that it refers to the same thing defined, as I understand it, fully in my last answer.

"The first claim of the reissue does not appear in the original patent at all, and it is something new inserted in the reissue intended to cover combinations which the claims of the original patent were unable to embrace.

"The first claim of the reissue is as follows:

"'A blast furnace with a closed breast where the slag is discharged through an opening or openings, cooled by water, substantially as set forth.'

"Here we find a new combination, that of a furnace with a closed breast, and a slag-discharge opening cooled by water. Now, this slag-discharge opening must be the slag-discharge piece of the second claim, and it must be cooled in the same way, and the water must be capable of performing the same function of controlling the slag flow.

"I fail to see that any combination rightfully exists between a particular form of furnace and a slag-discharge block, which, according to the original first claim, and indeed the second claim of the reissue, might be used with a furnace having an open breast.

"However, the first claim of the reissue accentuates the fact that (at least in the reissue) it was Lurmann's idea that the slag and unmelted foreign matter must all, in a liquid state, be passed out of the small opening in the slag-discharge piece, thus limiting Lurmann's invention, and confining it to a particular method of making iron and discharging his slag and foreign matter as a liquid, and not as in the old practice, partly as liquid and partly solid materials. This is in fact the departure that Lurmann made in the art. He liquifies all the materials discharged from his furnace, and takes them out as liquids.

"The function of the slag-block might be the same if combined with an old open-front furnace, the slag being drawn through it while the solid foreign matter was removed through the fore-hearth, the only difference being that in such an arrangement the block would not have passed through its hole or holes the liquified foreign matter, but its functions, so far as slag goes, would be the same.

"It is manifest that the Lurmann opening cooled by water cannot be *any* opening, for if such a broad interpretation be put upon the invention, then it can with justice be said that in every old furnace the slag was discharged through an opening cooled by water, for the tymp, the side-cheeks, and the dam of old furnaces were cooled by water, and they formed an opening through which the slag was drawn. Now, it is evident that this is not Lurmann's invention, for the reason that the water used is so far from the stream of slag as not to have any controlling influence upon its flow. Thus it is clear that Lurmann must be limited to an opening of such a size that water circulated around the opening can be used to control the flow of slag."

Patentability.

"III. * * * She admits that complainant surrendered the said letters-patent No. 70,447 to the Commissioner of Patents, and obtained a reissue of said letters-patent, which said reissue is numbered 3,204, and dated November 24, 1868, but she denies that said letters-patent No. 70,447 were surrendered for good and lawful cause, or that said reissued letters-patent No. 3,204 were obtained or granted in accordance with the law or for the residue

of the term thereof, and she further denies that the said reissued letters-patent No. 3,204 were for the same invention which was specified in the said original letters-patent No. 70,447, but, on the contrary, this defendant avers that said reissued letters-patent were obtained on the application of an assignee, and without the knowledge or consent of the inventor, for the purpose of expanding or enlarging the claims thereof so as to cover an invention other and different from that described and claimed in said original letters-patent, and that the said reissued letters-patent, as allowed and issued, were unlawfully and unwarrantably expanded and enlarged, and cover inventions other and different from and broader than those described and claimed in said original letters-patent, and that said reissued letters-patent are therefore void."

These allegations have already been discussed.

"XI. This defendant further answering, upon information and belief, denies that the said reissued letters-patent No. 3,204, dated November 24, 1868, is valid, but, on the contrary, alleges that it is invalid and void for the following reasons, to wit:

"1st. Because said reissue application was never assented to, signed, or sworn to by the inventor.

"2d. Because it is for an invention different from that claimed in the original patent.

"3d. Because the said reissue contains much new matter interpolated by the assignee.

"4th. Because the specification of said reissued letters-patent is not sufficient to enable any person skilled in the art or science to which the alleged invention appertains to make, construct, and use the same with practical success.

"5th. Because the alleged improvements attempted to be patented in said letters-patent did not involve or require invention, and did not differ in any patentable respect from what was before said alleged invention known and used in this country, or described in patents and printed publications.

"6th. Because there is no patentable combination between the elements constituting the first claim of said reissued letters-patent, and because no invention was required to produce the same."

The first three points last above mentioned have already been discussed.

As to the fourth clause: the specification is defective in not stating the size of the slag-discharge opening, as well as in not showing the water circulation or describing any method of regulating its flow, but leaves this to the invention and experiment of the constructor.

As to the fifth clause: a closed-breast furnace was old, and a water-cooled slag-discharge was old. What invention did it require to put the old water-cooled slag-discharge opening in the old closed-breast furnace? Let the Supreme Court answer, as it has done in the parallel case of Vinton *v.* Hamilton, 104 U. S. 485, 492, where the court says:

"But even if the application of a cinder-notch to a cupola furnace was first made by Vinton, the question remains whether, standing alone, it implies invention and is patentable.

"We think that this question must be answered in the negative. Neither a cupola furnace nor a cinder notch is new. The use of a cinder-notch for drawing off cinders from a blast furnace is as old as blast furnaces themselves. The function which the cinder-notch performs in the process covered by Vinton's invention is precisely the same for which it is used in a blast furnace. In smelting slag in a cupola-furnace it was found that the molten cinder accumulated and floated on the top of the molten iron. The application to a cupola furnace, for the purpose of drawing off the cinder, of the cinder-notch used in the blast-furnace to accomplish the same end, would occur to any practical man. When applied to a cupola furnace the same function was performed in the same way by the same means. In making this application there was no invention."

In Thompson *v.* Boisselier, 114 U. S. 1, 11, the court says:

"In the act of July 8, 1870, 16 Stat. 201, § 24, the patentee was required to be a person who had 'invented or discovered any new and useful art, machine, manufac-

ture, or composition of matter, or any new and useful improvement thereof;' and that language is reproduced in § 4886 Rev. Stats. So it is not enough that a thing shall be new, in the sense that in the shape or form in which it is produced it shall not have been before known, and that it shall be useful, but it must, under the Constitution and the statute, amount to an invention or discovery.

"To refer only to some more recent cases adjudged since these suits were decided below, this principle was applied in Vinton *v.* Hamilton, 104 U. S. 485, where it was held that 'a cupola furnace being old, and a cinder-notch being old, and the use of a cinder-notch to draw off cinders from a blast furnace being old, and the cinder-notch, in drawing off the cinder from a cupola furnace, performing the same function as in the blast furnace, it was held that the application of the cinder-notch to the cupola furnace would occur to any practical man, and that there was nothing patentable in such application."

The decision in Vinton *v.* Hamilton was also approved in Western Electric Mfg. Co. *v.* Ansonia Brass & Copper Co., 114 U. S. 447.

As to the sixth clause: even if the construction covered by the first claim of the reissue were novel, it would be unpatentable, there being no patentable relation between a closed-breast furnace and a slag-discharge opening cooled by water. The water-cooled slag-discharge opening would perform its function as such, equally well whether the furnace had an open or a closed breast. (Asmus himself contends that a furnace with a forehearth less than two feet long *is* a closed-breast furnace. X-30, p. 22.)

"I fail to see any combination rightfully exists between a particular form of furnace and a slag-discharge block, which, according to the original first claim, and, indeed, the second claim of the reissue, might be used in a furnace having an open breast." (Brevoort, Ans. 7, p. 71.)

"Merely bringing old devices into juxtaposition, and there allowing each to work out its own effect, without the production of something novel, is not invention."

Hailes *v.* Van Wormer, 20 Wall. 353.
Pickering *v.* McCullough, 104 U. S. 310.
Beecher Mfg. Co. *v.* Atwater Mfg. Co., 114 U. S. 523.

The Dunbar Suit.

"IV. And your orator further shows unto your honors, that on the 17th day of October, 1878, your orator brought suit in equity in the United States Circuit Court for the Western District of Pennsylvania, against the Dunbar Furnace Co., Charles Parrish and A. B. DeSaulles, for an injunction and account of damages and profits for the infringement of the said reissued letters-patent; that the said Dunbar Furnace Co. et al., defendants therein, filed their answer to the said bill, denying the validity of the said reissued letters-patent, the novelty of the invention therein described and claimed, and the infringement thereof by them; that issue was joined, proofs taken, and the cause presented to the said court, the Hon. Wm. McKennan, circuit judge, presiding, by counsel for both parties; and that thereupon Judge McKennan gave a decree sustaining the said reissued letters-patent as valid, and granting an injunction and an account against the said defendant; all of which matters and things are of record and unreversed at No. 215, November term, 1877, in the equity docket of said court."

Complainant offers no proof as to this allegation.

Defendant replies:

"VI. This defendant believes it to be true that complainant brought suit in equity in the United States Circuit Court for the Western District of Pennsylvania against the Dunbar Furnace Co., Charles Parrish, and A. S. DeSaulles, but not at the time alleged in said bill; but this defendant, on information and belief, charges that the said suit or proceeding against the Dunbar Furnace Company and the other defendants was not, in any fair sense, an adversary suit or proceeding, and that the statements in the bill of complaint in the fourth paragraph thereof, as to the same, are incorrect, misleading, and untrue; that it is true such a suit was commenced, and that some evidence was taken therein on the part of the complainant, but that there was no proper defence to said suit, no testimony taken on behalf of the defendants, and

no cross-examination of the complainant, the principal witness in the case; that no service was made upoh one of the defendants; that no answer was ever filed by him; that a decree was entered for the complainant against all the defendants, notwithstanding such want of service, and the case referred to a master for an account of profits and damages, and an injunction ordered to issue, but, so far as these defendants have been able to ascertain, no such writ of injunction was ever granted, and no further proceedings were ever had before the master, and no final decree was ever entered in said suit.

"This defendant further says that she is not party or privy to said alleged suit, and that she is not bound or concluded by the decision therein."

Defendant, in addition to her sworn answer denying the allegations of the bill on this point, has put in the entire record "Exhibit Dunbar Suit," fully sustaining the allegations of her answer. This is the only suit ever alleged to have been brought under the patent, and complainant's case can derive no strength from such a state of facts as therein exhibited.

Infringement.

The bill states (p. 2–3):

"V. And your orator further shows unto your honors, as he is informed and believes, that the said defendant, herein named, well knowing all the facts hereinbefore set forth, is now constructing and using blast furnaces, in some parts thereof substantially the same in construction and operation as in the said reissued letters-patent mentioned, the exclusive right and privilege to make and use which, and vend the same to other to be used, is by law vested in your orator.

"VI. And so it is, may it please your honors, that the said defendant, as your orator is informed and believes, without the license of your orator, against his will, and in violation of his rights, has made and used, and intends to continue still to make and use, the said improvements within the Eastern District of Pennsylvania, and refuses to pay to your orator any of the profits which they have made by such unlawful manufacture and use, or to desist

from the further infringement of said reissued letters-patent; all of which acts and doings are in violation of the exclusive rights and privileges so as aforesaid vested in your orator under and by virtue of said reissued letters-patent, and are contrary to equity and good conscience, and tend to the manifest injury of your orator in the premises.

"VII. To the end, therefore, that the defendant may, if she can, show reason why your orator should not have the relief hereby prayed, and that she may make a full disclosure and discovery of all the matters aforesaid, and upon her corporal oath, and according to the best and utmost of her knowledge, remembrance, information and belief, full, true, direct, and perfect answer make to the matters and things hereinbefore stated and charged, and particularly to such of the several interrogotories hereinafter numbered and set forth as by the note hereinunder written are required to answer, that is to say:

* * * * *

"3. Whether the said defendant has at any time, and when and during what period of time, made, used, or sold any, and how many, blast furnaces, constructed in whole or in part upon the principles and in the manner described in reissued letters-patent No. 3,204, granted to your orator as aforesaid? Describe minutely and in detail their construction and operation."

The answer replies (pp. 6, 7):

"V. This defendant denies that she is now infringing, or has at any time infringed, the said alleged improvement, or any part or parts thereof, as in said bill alleged, or that she has done, or intended to do, anything to disturb the possession, use, and enjoyment of the alleged exclusive privileges secured by the said reissued letters-patent and the receipt of the profits of the same, as in said bill alleged.

"VII. This defendant denies that she is now constructing or using any blast furnace, in some parts thereof, or any part thereof, which is substantially the same in construction and operation as in the said reissued letters-patent mentioned, the exclusive right and privilege to make and use which, and vend the same to others to be used, is by law vested in said complainant.

"VIII. This defendant denies that she has violated any rights of the complainant, or has made and used, or in-

tended to make and use, the said alleged several improvements, or any or either of them, within the Eastern District of Pennsylvania, or elsewhere; or that she has done, or intended to do, anything in violation of said reissued letters-patent, or of the alleged exclusive rights and privileges of said complainant thereunder, or by virtue thereof.

"IX. This defendant, further answering, says that shortly after the above-mentioned decree in the suit of the Dunbar Furnace Co., complainant alleged that this defendant was infringing the said Lurmann patent, and called her attention to said suit; that she replied, denying said infringement, or any intention of infringement, and requested to be informed in what the infringement consisted; that complainant replied, reiterating the charge of infringement, but without specifying wherein it consisted. Upon her refusal to listen to his demands, without knowing specifically what they were, complainant's attorney wrote specifying the alleged ground of infringement, referring to the Dunbar suit, and suggesting a settlement; that upon the advice of counsel, after full investigation, she declined to recognize said complainant's alleged rights; and that for more than three years she heard nothing more of complainant's alleged rights, during all of which time her furnaces were in operation with the full knowledge and acquiescence of said complainant.

"X. This defendant, further answering, says that the interrogatories contained in the 7th paragraph of the bill of complaint have all been hereinbefore specifically answered. As an additional answer to the third section thereof, this defendant denies that she has at any time made, used, or sold blast furnaces constructed, in whole or in part, upon the principles and in the manner described in said reissued letters-patent No. 3,204, the only furnaces used by her being constructed in substantial accordance with letters-patent No. 209,119, granted October 22, 1876, to Henry C. Grittenger, the manager of this defendant's works at Cornwall, Pennsylvania, with the exception of the omission of the water-cooling pipe in the weight-plate and around the slag-discharge opening, the use of such water-pipe having been for some time discontinued, this defendant not using any water-cooled arrangement to regulate or control the flow of slag through the furnace."

The charge of the 5th paragraph, it will be observed, is not that defendant is using blast furnaces in some *material* parts thereof substantially the same as *claimed* in said letters-patent, but "that defendant is now constructing and using a blast furnace in *some parts* thereof substantially the same in construction and operation as in the said reissued letters-patent *mentioned*, the exclusive right and privilege to make and use which, and vend the same to others to be used, is by law vested in your orator." Whether the "which" refers to the blast furnace, or to some parts thereof, or whether the claim alleged is to the use of the whole furnace or only some parts thereof, is difficult to make out from this ambiguous allegation, and we claim the benefit of the doubt.

Infringement is specifically denied in paragraphs 7, 8, 9, and 10 of the answer.

Paragraph 9 of the answer alleges a demand made upon defendant by complainant after the Dunbar suit, her refusal to settle upon the advice of counsel after full investigation, and complainant's wilful acquiescence in her use of her furnace for more than three years after such denial of infringement, and until the patent was just about to expire. Such laches as this at all events does not strengthen complainant's case.

The Grittinger patent, mentioned in the tenth paragraph of the answer, will be found in the record, p. 49.

Complainant originally charged infringement generally of all seven claims of the reissue. While taking testimony, the charge was limited to the first and sixth claims. On the argument below it was further limited to the first claim only (p. 120), which was for—

"1. A blast furnace with a closed breast, where the slag is discharged through an opening cooled by water, substantially as set forth."

It is not pretended that defendant's furnace could by any reasonable process of construction be held to infringe any claim of the original patent, for such furnace con-

tains neither a slag-discharge piece cooled by water, nor does it regulate the slag-discharge by water-cooling, as will hereafter be demonstrated. Defendant's alleged infringing furnace is called the North Cornwall Furnace, which we will now investigate.

The North Cornwall Furnace, as Incorrectly Described by Asmus. (p. 11.)

"Int. 1. State your name, age, residence, and occupation?

"A. George Asmus; age, fifty-four years; residence, New York City; occupation, mining engineer and metallurgist.

"Int. 2. Are you the complainant in this case and the patentee of reissue letters-patent No. 3,204, dated November 24th, 1868, for improvement in blast furnace?

"A. I am.

"Int. 3. Are you familiar with the construction of the defendant's furnace in this case; if so, please describe it?

"A. I am. The furnace is constructed with an absolutely closed front, and the cinder is discharged directly from the hearth through an opening cooled by water. I produce a sketch showing how this is accomplished. The plate A has a prolongation of about twelve inches, reaching through the wall of the hearth towards the inside. This plate is thoroughly cooled by pipes through which water is constantly running. An opening about nine inches wide and ten inches high is left in this plate, through which the cinder is discharged. The rear of the dam-plate B is walled up.

"Int. 4. Describe how the opening through the plate A is closed, and how the tapping of cinder is effected?

"A. The opening is filled with clay, and, at proper intervals, a hole is punched through this clay in order to tap the cinder.

"Int. 5. In what direction is the opening through the clay made?

"A. Horizontally."

(Sketch referred to by witness offered in evidence, as "Exhibit Asmus Sketch No. 1.")

"Int. 17. Referring now to the defendant's furnace *as shown by* 'Exhibit Asmus Sketch No. 1,' please state whether or not the construction is such as to affect the

protection of the wall at the cinder outlet which you have just described?

"A. It is. The cinder outlet C in the sketch is *protected from three sides*, it being made through the water-cooled plate A. (p. 14.)

"Int. 23. Please state when, where, and under what circumstances you saw the defendant's furnace, and whether you ever made any demand for royalty for the same?

"A. I saw the furnace on May 17, 1883. It was in blast. It was shown to me by the manager, Mr. Grittinger. I told him that I considered this construction as an infringement on my patent, and that the owner would have to take out a license. The furnace is situated near Lebanon, Pa., and is called the North Cornwall Furnace. (pp. 15–16.)

"X-int. 24. Please examine 'Exhibit Sketch No. 1,' and your third answer relating thereto. You say defendant's furnace has an absolutely closed breast, while the sketch shows an apparent opening; please describe the construction a little more clearly, as to how the space between A and B is closed?

"A. The space between A and B, as sketched in No. 1, indicates only that amount of distance to show that they are different plates. In fact, the lower edge of plate A is at a level with the upper edge of plate B, or nearly so.

"X-int. 25. Please describe briefly the parts represented in that Sketch No. 1 with regard to the reference letters marked thereon.

"A. A is an upright plate, cooled by water, with a horizontal prolongation reaching about *twelve* inches towards the inside of the hearth, and in this plate, cut out of it and the prolongation, is the opening, C, through which the cinder is discharged. The cooling water pipes extend through the whole plate, A, to the upright part and *through the horizontal extension. The plate B is a little in front of plate A.* The former is in circle with the outside of the hearth, while the plate A is set in deeper into the furnace, forming a niche apparently made to get nearer to the hearth where the cinder is fluid. The plate B *may technically be called a dam-plate* here, though *the horizontal space between* A and B does by no means *constitute a fore-hearth*, the space being walled up and the cinder being discharged through the opening, C, by a horizontal thrust, and directly from the hearth. D' indicates the tapping-hole for the iron." (pp. 16–17.)

In contradiction of this, defendant's manager, Grittinger, says (p. 58):

"Q. 13. The complainant, in his 23d answer, states that you showed him the furnace at North Cornwall, May 17th, 1883, and put in Asmus Sketch No. 1 as a representation of the cinder-flushing arrangement of that furnace at that time. Examine that sketch, now shown you, and state whether it correctly represents the construction of that furnace at that time?

"A. It does not represent the construction at that time.

"Q. 14. State in what particulars it is incorrect.

"A. He has the projection of the base of tymp into the furnace as being twelve inches long, whereas it is but six, and he does not show the cinder-block attached to outside of tymp nor the bottom plate under the cinder-block, nor the method of closing the opening in said cinder-block by means of a door attached to a curved bail. 'Exhibit Grittinger' is a correct representation of the arrangement there and now used."

Complainant's sketch and description are both largely drawn from his imagination in many particulars. He saw the furnace only when in blast, with its internal parts necessarily concealed; his mistakes are thus easily accounted for, as far as its internal arrangements are concerned, but this will not account for his omission of so much of the external apparatus.

Defendant's Furnace as Actually Operated.

Grittinger (pp. 54–58):

"Q. 1. State your name, age, residence, and occupation.

"A. My name is Henry C. Grittinger; aged forty-two years; residence, Cornwall, Pa.; occupation, blast furnace manager.

"Q. 2. What is your present occupation, that is, by whom are you at present employed?

"A. I am employed by Margaret C. Freeman and R. W. Coleman's heirs. I have charge of North Cornwall Furnace and the two Bird Coleman Furnaces, all located at Cornwall, Pa.

"Q. 3. How long have you been so engaged?

"A. Since 1871 at North Cornwall, and since 1882 at Bird Coleman.

"Q. 4. Describe the construction of the cinder-flushing devices used in these three furnaces.

"A. I can best do this by reference to certain sketches made by me, and which I now produce."

(Sketches offered in evidence respectively marked Exhibits Grittinger Sketches, 1, 2, 3, and 4.)

"The one marked No. 1 shows the first method used from 1875 to 1878. This was the first year the furnace started; that is, the North Cornwall Furnace. * * *

"The sketch No. 1 shows an open fore-hearth with a removable weight-plate and prop. It has a water-cooled dam, side-cheeks, and tymp. In working a furnace with this fore-hearth the weight-plate was raised from six to eight inches above the level of top of dam, as shown in the sketch. The slag or cinder was tapped through an opening between two pigs placed between the top of dam and the weight-plate. The molten iron was tapped out through an opening in dam and dam-stone, as shown in sketch. It was customary to remove the weight-plate and prop every morning, after tapping out the iron, for the purpose of taking up or breaking the crust that formed under the weight-plate. A clay stopper was then packed under the tymp. The object of the stopper—which seldom exceeded six inches in depth below the tymp—was to reduce the level of the molten slag in the main hearth, and at the same time protect the tymp from being cut away by the molten slag and blast coming in contact with it. The weight-plate was then put in place again on a level with top of dam, the pigs having been taken away.

"After the blast having been on the furnace for several hours, the weight-plate was again removed, the pigs replaced on the top of dam, and the molten cinder was forced up to a level with top of pig by a pressure of blast in the furnace. Clay and coal-dirt were forced down between side-cheeks and molten slag to make it more easily removed, and the weight-plate and prop were again hour longer the slag was tapped through a small aperture put into position.

"After blowing the furnace about an hour longer the slag was tapped between the pigs, the aperture being usually about one inch in diameter. The weight-plate was about two feet and a half square, being the distance between the tymp and the dam and the side-cheeks on either side. The cinder was allowed to run through the

opening between the pigs until the blast blew through; the opening was then stopped up with clay. After running on a short time longer the weight-plate and prop were again removed for the purpose of working the furnace.

"The working of the furnace consisted in the removal of the effete or dead matter that accumulated in the fore-hearth by forcing the same upward with a light-blast pressure, and then shovelling it off. It was also necessary at times to loosen the material by means of wringers and crust-bars, which were inserted in the fore-hearth. It frequently happened that the slag and effete material in the fore-hearth became chilled up, and could be removed only with difficulty.

"In such cases we were compelled to abandon the working of the furnace in the manner above described, and remove the slag through the opening marked 'Cinder-notch' on sketch No. 2, until the fore-hearth, by the operation of the furnace, became hot enough to undermine the crust and melt the effete matter and make the crust removable. We frequently ran for weeks with the fore-hearth in this chilled condition. We found that we were able to control with difficulty the sides of the cinder-notch, owing to the blast and slag enlarging it to too great a size. We thereupon introduced a regular tuyere to tap the cinder through, but found that it did not answer the purpose, because the coils were cut in a very short time. We then tried a large cast-iron pipe, lined with clay, with better success, but experienced difficulty in keeping the slag from chilling up at the lower end. We then tried a cast-iron block, lined with fire-brick, with indifferent success.

"We then had a new tymp made with semi-circular opening, as shown in sketches Nos. 3 and 4—No. 3 being in vertical longitudinal section, and No. 4 being a front view. Also attached to same a cast-iron cinder-block, lined with fire-brick, as shown in said sketches. We also placed a cast-iron weight-plate under the cinder-block for the purpose of keeping it in place.

"The first bottom-piece on plate and cinder-block had coils of pipe through them for the purpose of protecting the material of which they were constructed; but, after several trials, the water-cooling pipe in same was abandoned, as the sudden expansion that was caused by the

flow of slag through the same and the chilling after-effect of the circulating water caused the same to crack in a very short time and render them useless.

"We, however, continued using circulating pipe in both the tymp and the dam, which are the only water-cooled appliances we are using in connection with our cinder-flushing arrangement, and this is done merely to protect the materials of which they are composed.

"This description applies more particularly to the North Cornwall furnace owned by Margaret C. Freeman.

"Q. 5. I now show you the model 'Exhibit Cinder Flush.' What does it represent?

"A. This represents a vertical sectional view of the arrangement in use at North Cornwall Furnace. * * *

"Q. 6. Did you, or not, ever use practically, during the running of the furnaces referred to in the last question, water to cool anything other than the tymp and the dam?

"A. Nothing connected with the cinder-flushing arrangement.

"Q. 7. Please describe the operation of the furnaces we have referred to, so far as the flushing of cinder is concerned?

"A. In the use of cinder-notches of my construction I have returned to the general idea of the old open-hearth furnace, in that I do not dissolve the effete matter and pass it out as a liquid with the slag, but I discharge the effete or dead matter in the solid form, blowing it out in the solid form with the slag; thus, when I wish to flush cinder from any of the furnaces, I first slack the blast, then open the door closing the cinder-block, remove the clay stopping and part of the coal dust that has been packed under the tymp; the blast is then put on to the furnace and a hole pricked through the remaining coal dirt, which soon enlarges to the full size of the opening of the cinder-block and allows full egress for the slag and solid material that is washed out with it. After the cinder has been all flushed out the blast is thrown off the furnace and the tapping-hole or cinder-notch is closed up with coal dirt rammed under the tymp, and an outside stopper of clay is rammed in, and the door closed and fastened on same. The blast is then put on the furnace and the smelting operation then resumed.

"Q. 8. Please state the size in cross-section of the cinder-openings that you are using?

"A. The opening in casting is fourteen by fourteen inches. This we reduce generally to an opening ten by ten inches by a clay packing or lining. In certain conditions of the furnace we reduce the opening to an area of about fifty square inches. This is done by packing in clay. When the slag is very hot and fluid we reduce the size of opening to the smallest size above named, and where it is thick and sluggish we open to full size cinder-notch, fourteen by fourteen inches, by taking out all clay.

"Q. 9. You speak of reducing the area of the cinder-notch. Have you or not ever been able to effect such reduction by circulating water in tymp and dam, and thus causing the slag to adhere to the inside of the cinder-notch?

"A. We never could, but experienced in first using water-coils in our cinder-block, that instead of the water protecting the cast-iron of which the cinder-block was made, and causing the slag to adhere to same, the iron was soon cut away and the coils were cut and began leaking.

"Q. 10. How long did such experimental use of the water in the cinder-block continue?

"A. Only a few weeks, as we found the renewal of the blocks cooled with water to be too expensive.

"Q. 11. Then the furnaces were never run practically with water at any other parts of the cinder-flushing arrangement than is shown in white on 'Exhibit Cinder-Flush?'

"A. No, sir; they were not.

"Q. 12. Have you ever formed the portion of the tunnel or cinder-block in front of the tymp of any material other than cast-iron?

"A. We have frequently formed it of fire-brick, using two sixteen-inch blocks on each side of the opening, and covering the same with block. Such devices have lasted six months fully, and we are now using such a structure at No. 1 Bird Coleman Furnace.

(Grittinger cross-examined, pp. 59–60):

"X-Q. 17. In your fourth answer you say, 'We then tried a cast-iron pipe lined with clay.' Was that pipe water-cooled?

"A. No.

"X-Q. 18. In the same answer you say, 'We then tried a cast-iron block lined with fire-brick.' Was that block water-cooled?

"A. It was not.

"X-Q. 19. What is the size of the solid matters which come out with the slag in your furnaces?

"A. It varies from one cubic inch up to fifty cubic inches, and varied from one to five inches in diameter.

"X-Q. 20. What was the modified arrangement that you have mentioned at the end of answer four?

"A. It consisted in moving the cinder-notch around to one side clear on the dam, which latter remains at the fore part of the furnace as heretofore. The cinder-notch is composed of a water-cooled tymp and side-cheeks and a cinder passage formed by a block or tunnel extending out from the tymp. The tunnel in front of the tymp is made of an ordinary casting, separate from the tymp and removable; it is not water-cooled; and frequently, when it was burned out, fire-bricks at the side and top were substituted for it.

"X-Q. 21. In your answer No. 7, describing the operation of flushing cinder at defendant's furnaces, you say, 'When I wished to flush cinder from any of the furnaces I first slack the blast.' Please state how long the blast remained slackened for that stop of the flushing operation?

"A. It was only for a long enough time to remove the clay stopper and put a splasher-plate in front of the cinder-notch to prevent the slag from flying over the casting-house. The slackening of the blast is not necessary for the flushing operation, but it is essential for the safety of the men. We use 9 to 10 pounds of blast pressure, and have sometimes over a 10-inch opening. The blast is slackened for one-half to a minute; the whole flushing operation takes about 2 or 3 minutes, whereas, with a small opening, it would take fully 15 minutes. The two to three minutes includes the whole operation up to the closing of the door and putting on the blast. If the furnace is working cold it will take longer. I have known it to take five minutes, but this is exceptional.

"X-Q. 22. How often do you flush cinder in 24 hours?

"A. Nine times; we cast every eight hours, and flush three times between each casting operation.

"X-Q. 23. You tap your metal directly from the crucible of the furnace through the wall, do you not?

"A. Yes, sir.

"X-Q. 24. In the old or open-front form of furnace the operation of which you have described, the stopper, extending down from the tymp, acted as a trap between the hearth and fore-hearth, did it not?

"A. No, sir; the tymp was above the level of the dam, and it could not act as a trap.

"X-Q. 25. I mean, did it not prevent the blast from passing out through the fore-hearth when the weight-plate was removed until the cinder fell below the lower end of the stopper?

"A. It did; but the object of the clay stopper in our practice was not to form a trap, but to protect the tymp and to reduce the level of the slag."

Campbell (pp. 60–61) says:

"Q. 3. Please look at Grittinger Sketch No. 1, and state whether or not that is a fair representation of what is commonly known as an open-front furnace.

"A. Yes, sir."

Cooke (pp. 65–66) says:

"Q. 9. Are you acquainted with the mechanism used by the defendant herein?

"A. I visited the furnaces of the defendant in 1880, and I then became acquainted with their mechanism and methods.

"Q. 10. I now show you a model 'Exhibit Furnace,' and I direct your attention to the portion of the model 'Exhibit Grittinger' I now hand you, and ask you what it is?

"A. To the best of my knowledge it represents the front of the North Cornwall Furnace.

"Q. 11. Please state, referring to the two methods of operating blast furnaces, about which you spoke in previous answer, which of those two methods was practiced by the defendant at the North Cornwall Furnace?

"A. It is practically the first method, the washing-out method.

"Q. 12. I now show you a model showing a section of the devices now used by the defendant, in which model the water channels are shown in white, and I ask you whether or not such water circulation would have any effect whatsoever upon the flowing stream of molten slag and unfused impurities?"

("Exhibit Cinder Flush" shown witness.)

"A. In my opinion the water would have no effect whatever upon the flowing of the slag.

"Q. 13. Please state what you consider the device used by the defendant to be?

"A. It is a modification of the open-hearth furnace, as they retain the tymp, side-cheeks, and dam, the fore-hearth being filled with brick instead of infusible clay, or part clay and part brick. The method of discharging the slag through an opening large enough to admit the passage of large pieces of slate, bone, or unfused limestone resembling the method employed in the open-front furnace previously described more than the method of discharging the slag through the Lurmann patent.

"Q. 14. You have referred to the Lurmann patent. Are you acquainted with the Asmus reissue No. 3,204?

"A. I have read it.

"Q. 15. I read you the following statement therefrom: 'The flow of the cooling water through the cinder-block, D, is regulated for the purpose of controlling the discharge of the slag through it. By allowing much cooling water to circulate through its water channels, or pipes, the temperature of the block, D, is lowered sufficiently to allow a coating of slag to adhere and choke its discharge openings, which are of less diameter in the middle than at their ends. By reducing the flow of cooling water the cinder-block is allowed to retain a higher temperature, and in consequence the slag is melted out of the discharge openings, and they become clear and open, and permit the slag to flow without interruption.' I want to know whether or not such an action is possible with the defendant's structure, as you understand it?

"A. No; decidedly no.

"Q. 16. Do you find in the defendant's structure any cinder-block having the capacities of the one referred to in the quotation in my last question?

"A. Assuming that 'Exhibit Grittinger' correctly represents the defendant's structure, I would say no."

Weimer (pp. 67–69) says:

"Q. 1. What is your name, age, residence, and occupation?

"A. My name is P. L. Weimer; my age is 55 years; my residence is Lebanon, Pa.; and I am by occupation a manufacture of blast-furnace machinery.

"Q. 2. For how long have you been practically familiar with the operation of blast furnaces?

"A. I have given special attention to the operation of blast furnaces since 1856.

"Q. 3. Are you familiar with the working of a blast furnace smelting ores?

"A. I am, and have been for twenty-nine years.

"Q. 4. Will you briefly explain the process, particularly that part which relates to the formation of cinder?

"A. In the manufacture of pig-iron the raw material, iron ores, fuel, and necessary fluxing material, generally limestone, are charged into the top of the furnace in fixed proportions. This material, in its descent through the furnace, is acted on by the ascending blast; the iron ore, in its conversion into metallic iron, throws off its gangue, which gangue unites with the flushing material and ashes of the fuel, forming a liquid slag or cinder, which passes the tuyeres into the crucible, from whence it is removed in various ways.

"Q. 5. Is there any other material passing into the crucible of the furnace except this slag?

"A. Yes; fuel, molten iron, and solid foreign matter obtained from the ores, flux, and fuel that has not liquified.

"Q. 6. In what manner is the liquid cinder removed from the crucible of the furnace?

"A. The older practice is to draw it off at stated intervals through an aperture made through a clay stopping in the hearth of the furnace. Mr. Lurmann has a patented device for drawing the liquid cinder either in a constant flowing stream or at intervals. Mr. Grittinger also has a patented device for drawing away both the liquid cinder and foreign solid material at stated intervals.

"Q. 7. Are you familiar with Mr. Lurmann's device for drawing away cinder; if so, please describe it?

"A. Mr. Lurmann's device consists of a hollow metallic block, with an aperture through its centre, through which the liquid cinder is drawn while water is allowed to circulate through the block.

"Q. 8. Where is this water-cooled block of Mr. Lurmann located in the furnace?

"A. Immediately under the tymp, and as near the interior wall of the crucible as possible.

"Q. 9. What is the size of the aperture in Mr. Lurmann's device?

"A. The aperture through which the cinder flows varies in size from one inch to two or two and one-half inches in diameter.

"Q. 10. Are you familiar with Mr. H. C. Grittinger's device for drawing cinder from a blast furnace; if so, please describe it?

"A. Mr. Grittinger's device consists of a horse-shoe-shaped opening made in the tymp of the furnace, in front of which is placed a heavy casting of a shape to correspond with the horse-shoe opening in the tymp. This casting is almost twenty inches in length, and has an aperture of the area of one hundred square inches; it is provided with an iron gate or stopper for closing the aperture when not in action. When sufficient cinder has accumulated in the crucible of the furnace, Mr. Grittinger suddenly opens this large aperature of one hundred square inches and allows the cinder to flow out with violence, carrying with it the solid foreign material that has passed tuyeres. As some iron ores throw off large quantities of this solid matter, Mr. Grittinger's device allows it to flow away with the liquid cinder, and avoids it accumulating in the bottom, to be more slowly dissolved and pass away, as with Mr. Lurmann's device, or being shovelled off at stated intervals, in accordance with the older practice.

"Q. 11. Is it practicable to accomplish the removal of solid matter, such as Mr. Grittinger flows away with his 100 square area of opening, through Mr. Lurmann's device?

"A. No. By the Lurmann process it must remain and dissolve in the liquid cinder before it can pass through the small aperture he provides.

"Q. 12. Where does Mr. Grittinger's mode of removing the cinder and foreign material differ from the older furnace practice of doing this work?

"A. In the older practice the cinder was drawn, at stated intervals, through a comparatively small orifice, similar in size to that now employed by Mr. Lurmann, while at fixed times the opening was greatly enlarged, so as to admit of a large shovel being introduced, by means of which the foreign material was removed. Mr. Grittinger's differs from the fact that his opening is sufficient to remove all foreign matter along with the cinder, and the violence of flow in such a large aperture is sufficient to accomplish all that was performed with the old practice of shovelling off.

"Q. 13. What is the fore-hearth of a furnace?

"A. The fore-hearth is a passage that leads from the outside of the furnace into the crucible, and from which, in ordinary practice, the cinder and iron is drawn.

"Q. 14. Does Mr. Lurmann use a fore-hearth?

"A. No. He draws both iron and cinder direct from the crucible of the furnace; his dam is directly under his tymp.

"Q. 15. Does Mr. Grittinger's cinder-drawing device and iron tap draw their stock away from a fore-hearth?

"A. The cinder device is placed outside of the tymp and dam sufficiently far back to accommodate the cinder device, both of which arrangements demand a fore-hearth."

Brevoort (pp. 73–76) says:

"Q. 11. Please compare the combinations and mechanical devices recited in the first and second claims of the Asmus reissue No. 3,204 with the cinder-flushing devices used by the defendant, and state whether or not you find in the said defendant's device the combinations and mechanical devices which are pointed out and claimed in the first and second claims of the said Asmus reissue No. 3,204.

"A. I have carefully made the comparison called for in the question, and I am clearly of the opinion that the defendant's device does not contain the combinations or the mechanical devices which are recited in the first and second claims of the Asmus reissue.

"In giving my reasons for this opinion I will first state what I understand to be the structure used by the defendant. The defendant's structures are blast furnaces; they are used to smelt iron, but flush the cinder in a way very much like the old open-hearth method, and utterly unlike Lurmann's method. Referring to the sectional model of the defendant's structure, it will be seen that a large arch-shaped tunnel leads from the interior of the furnace to the front thereof, an opening being made in the tymp for the purpose, and of the shape desired. This tunnel is lined with coal dirt and slag. This tunnel is not a water-cooled aperture, the only water that is used being that which is in the tymp and in the dam, the water in these parts being used, located, and circulated as was always done in the old furnaces, the only difference being that a recessed dam is used, which has nothing to do with the cinder-tapping

arrangements whatsoever. The use of the water in no way affects the flow of the slag, to retard it, or regulate its flow.

"First of all, no amount of water which could be practically used would, in use, control a mass of molten slag as large as is allowed to flow through the defendant's flushing tunnel; second, as the water is used, the only part of the tunnel cooled is so small as not to amount to a cooling at all.

"When the slag is flushed with the defendant's device, the front of the tunnel is opened, the stopping is removed, the blast is put on, and the slag, combined with such matters as are not fused, is violently ejected from the furnace through the tunnel, which, after the flush is stopped, is again closed, and the work of the furnace is proceeded with.

"The blast is slacked before the tunnel is opened, and, while it is being opened and while it is being closed, it is thrown off. No attempt is made with defendant's device to fuse those matters which are not readily melted, but, as in the case of the old open-hearth furnace, the unfused materials are ejected from the furnace.

"The defendants use and have used brick slag-tunnels interchangeably with their iron ones, showing that not even metal was necessary for their construction.

"Now, comparing such structures with those of the first and second claims of the Asmus reissue, I find as follows: Referring to the second claim first, it is clear that the defendants have not got the block D, for they have not a block with a small hole through it for the slag to pass out, and they have no water circulation which is adapted or capable of controlling the stream of cinder through the block.

"Neither is the defendant's tunnel capable of removal, thus leaving a large opening as Asmus describes, but, on the contrary, part of the tunnel is made up of a passage directly through the brick of the furnace itself, and consequently there cannot be said to be, in the sense of Asmus, any cinder-block whatsoever.

"Turning now to the first claim, this is, as I have stated, a combination so called, the first element being a furnace with a closed breast, and the second element is an opening cooled by water.

"Now, as I have already said, this opening cooled by water is either the cinder-block D, or else it is something which the patent does not describe or show. Of course it cannot be this latter, but must be understood as referring to the only opening described or shown which is cooled by water, and that is the block D.

"In comparison with the Asmus reissue the defendants' furnace is an open-front furnace, for through its cinder-discharge tunnel the materials not dissolved in the slag are discharged in the solid form.

"It is clear that the defendants do not have the combination, so called, of the first claim of the reissue, for they have not a furnace with a closed breast in the sense of Asmus, and assuredly they have not got the opening cooled by water which is the second element of the claim.

"It must also be borne in mind, and it is very important, the defendants do not operate their furnace on the same plan, as is essential with the Asmus arrangement, which can only be used when the solid foreign matter is allowed to dissolve in the slag before it is ejected from the furnace.

"Thus, I am clearly of the opinion, that the defendants' structures do not contain either the invention of the first or second claim of the Asmus reissue.

"Q. 12. Can you produce a model illustrating the Asmus invention?

"A. I can; it is now in evidence, marked 'Exhibit Lurmann.' This wooden model shows a vertical cross-section of the Asmus device, as shown in the drawings of the reissue.

"The cinder-block is shown with the water circulating around the small slag-discharge hole, which, it can readily be seen, would be kept cool thereby, thus giving a practical control of the stream of slag by means of the water used. I am informed that in practice the diameter of the hole in the Asmus cinder-block is about one and a half inches, thus giving an area in cross-section of from nearly one to one and a third inches. Now, with the defendants' structures, the area is never less than fifty square inches, and sometimes it runs up to about two hundred square inches.

"It can be readily seen that the mere ring of water surrounding in part the tunnel where it passes the tymp

could have no appreciable effect upon this enormous body of molten material.

"In the model the water spaces are painted white, the iron portions block, and the brick portions yellow. The little hole in the black is also painted yellow, in default of a better color for this part."

Brevoort (pp. 77–78) says:

"Q. 17. I call your attention to the fact that Asmus, in his reissue, refers to water-cooling his slag-piece and his plate C. Please state whether you find in the description of his patent or in the drawing any water-circulating arrangement.

"A. I do not. In Fig. 4 of the drawing he shows some water channels in his cinder-block, but so far as the drawings go these are the only water channels shown. The specification mere states that the parts are water-cooled, but does not describe anything as to how the channels are arranged, or how the water which is to flow through them is controlled." (Brevoort, Ans. 17, pp. 54–55.)

In the normal working of Lurmann's furnace, as described in his patent, the entire charge was melted, and everything but the iron was discharged in a continuous liquid flow, through a small opening cooled by water, to regulate the discharge.

To meet the contingency of irregular working the slag-discharge block was made removable, so as to remove infusible material.

As defendant has no such discharge-block, but invariably flushes all her slag and effete material, both solid and liquid, intermittently through a large opening, not water-cooled, she manifestly could not be held to infringe complainant's normal mode of operation.

Complainant endeavors to overcome this obstacle by testifying in rebuttal (Hahn, Ans. 24, X-73) that Lurmann's claim covers at the same time a continuous liquid discharge of all effete matters, through a small opening in a water-cooled block, and the removal of this block and discharging solid effete matter intermittently through a large opening.

To this claim there are several answers:

1. The claim in question is interpolated for the first time in the reissue.

2. A claim cannot be maintained for any and all methods of attaining a result.

3. In case of elements of a combination acting diversely under different circumstances, both conditions cannot be covered by the same claim. That is to say, complainant's first claim cannot cover at the same time the combination of a closed-breast furnace and a large slag-discharge water-cooled opening—two elements—and the combination with these elements of a removable slag-discharge piece or cinder-block.

Prouty *v.* Ruggles, 1 Story, 571; 16 Pet. 341.

Recapitulation.

To recapitulate:

I. The reissue is void—
   1. As improperly obtained.
   2. As being broader than the original.
   3. For want of patentable subject-matter.
   4. For insufficiency of description.
   5. The claims are anticipated.

II. Defendants do not infringe.

The Master's Report.

November 10, 1887, the master's report awarding nominal damages, only, to complainant was filed. Complainant alone excepted.

These exceptions are so vague and indefinite in their nature as simply to amount to an appeal for a rehearing of the case by the court.

Complainant's Exceptions

may be classified as follows, changing their order somewhat for convenience of consideration:

1. (FIFTH EXCEPTION.) "*Divers other good causes of exception*" besides those specified.

Under the rulings of the Supreme Court in Story *v.* Livingston, 13 Peters, 359–366, this exception is clearly objectionable, as too general in its nature.

Foster *v.* Goddard, 1 Black, 506–509, while apparently qualifying the strictness of the ruling in Story *v.* Livingston, holds "that the exception should distinctly point out the finding and conclusion of the master, which it seeks to reverse."

If the court deems these exceptions sufficiently specific, then, according to the last-cited case, the exception "brings up for examination all questions of fact and of law arising upon the report of the master relative to that subject."

In other words, it is an appeal, or a rehearing.

2. (THIRD EXCEPTION.) The master "*has not stated fully all the facts and special circumstances explanatory of the grant of complainant's licenses, but has omitted to state or give due weight to certain of such facts and circumstances which are material, and the omission of which is prejudicial to complainant.*"

This is simply a general dissent from the master's findings. What "certain of such facts and circumstances" are excepted to does not appear, and we are nonplussed how to discuss such an exception without reviewing all the facts in controversy.

In Green *v.* Bishop, 1 Cliff. 195, the court says (omitting irrelevant matter):

"CLIFFORD, J. Twelve exceptions are taken by the respondent to the report of the master. Excluding the eleventh, which deserves a separate consideration, all the residue may conveniently be divided into three classes.

"*First.* Such as merely express dissatisfaction with the report in the form of general objections to the conclusions of the master upon the evidence, or to the results arrived at by him, and are in substance and effect nothing more than an appeal from the determination of the master to the court to revise and reverse his decision, or, rather, to determine the matters in controversy on a review of the testimony, as if no order had been passed or report made,

and precisely as in case of final hearing upon pleadings and proof without reference. * * *

"*Second.* Such as allege directly or indirectly that certain other matters are omitted or insufficiently stated in the report, which, it is alleged, the order of reference required should be reported. * * *

"*Third.* Such as complain in effect that certain other matters are omitted in the report which it is alleged appear in the proof, without affirming whether or not they are required to be reported by the order of reference, or even suggesting that the master was required to include them in the report. * * *

"Exceptions to a master's report are written enumerations of the errors alleged by the complaining party, and of the corrections he requests to have made; and they should be so framed as not only to allege error in general terms, but should be sufficiently definite and explicit to enable the court understandingly to decide on each point in dispute. Such appears to be the just and convenient rule to be deduced from the best considered modern cases upon the subject, and it is one of great importance in this class of legal investigations, and ought in general to be strictly enforced. Were it otherwise, the reference to the master would be of little or no avail, as it would involve the necessity for the court to look upon the whole testimony laid before him, and to decide the controversy as upon final hearing, without reference as on appeal.

"General allegations of error, without pointing to any particulars, are clearly insufficient, for the reason that, if allowable, the losing party might always compel the court to hear the cause anew, and should that practice prevail, references such as made in this case would become useless and burdensome, as they would only operate to promote delay and increase the expenses of litigation, without relieving the court from any of the labor of the trial, or ever accomplishing anything of value to either party.

"Marshall, Ch. J., said, in Harding *v.* Handy, 11 Wheat. 126, that the report of the master is received as true when no exception is taken; and the exceptions are to be regarded so far only as they are supported by the special statements of the master, or by the evidence which ought to be brought before the court by reference to the particular testimony on which the excepting party relies; and

the same court held, in Story *v.* Livingston, 13 Pet. 366. that exceptions to the report of a master in chancery are in the nature of a special demurrer, and the party objecting must point out the error; otherwise the part not excepted to will be taken as admitted. That doctrine had been previously recognized in Wilkes *v.* Rogers, 6 Johns. 592, and in Dexter et al. *v.* Arnold et al., 2 Sumn. 125, and is not different from the rule which generally prevails in chancery courts. Da Costa *v.* Da Costa, 3 P.W. 140. * * *

"These references to the order under which the master acted, to the report made in pursuance thereto, and to the nature and character of the objection to the finding, will be sufficient to demonstrate the proposition, that *the only question that can arise under the exception is whether the master has duly considered and properly weighed the evidence submitted to his consideration.*

"It is, therefore, in every sense, an appeal from the decision of the master, in a matter of fact properly referred to him, and clearly within the scope of the power conferred in the order of reference, and in substance and reality requires the court to review the whole evidence, and to revise and reverse the decision of the master upon a question depending entirely upon the weight and effect of the testimony on which the decision was made.

"It should be observed that the exception under consideration contains neither suggestion of mistake nor gross error, nor imputation of undue influence or fraud; and I hold that an exception, like the present, unaccompanied by any such suggestion or imputation, and which merely alleges that the master has arrived at a wrong conclusion upon the evidence, without pointing out any specific portion of the testimony to support the allegation, cannot in general be regarded as sufficient to put the finding of the master in issue, or to require the court to review and revise the same in a matter of fact dependent entirely upon the weight and effect of the evidence submitted to his consideration.

"Exceptions irregularly taken may properly be overruled without any examination of them in connection with the report of the master. Story *v.* Livingston, 13 Pet. 386. Nevertheless, if the court were satisfied that any error had been committed by the master in the finding referred to in the exceptions, it would be competent for the court to recommit the report, in order that the error

might be corrected; and in a case where the error was satisfactorily and clearly shown, it would become the duty of the court to adopt that course. Such questions, however, bear a strong anaolgy to motions for a new trial at common law, in which it is not usual to interfere in a matter of fact unmixed with any question of law depending upon the weight and effect of the evidence, unless it is clearly shown that there has been manifest error."

Following Green *v.* Bishop, the court held in Bridges *v* Shelden, 18 Blatch. 295–507 (7 Fed. Rep. 17, 34, 35):

"There is no doubt about the power of a court of equity to revise the report of a master by supplying facts material which are shown by the evidence, but not stated in the report, by setting aside the findings of facts not shown by any evidence, or which are contrary to the evidence, and when errors in law have controlled or influenced the finding of material facts; but this revisory power of the court has never been considered as covering a right for a party to appeal from the master to the court upon disputed questions of fact, determined by the master as matters of fact upon conflicting testimony. Greene *v.* Bishop, 1 Cliff. 186. The question here is purely one of fact; it arose upon the pleadings, and either party might have had it tried and determined upon evidence taken according to the usual course, before the cause went to the master. The cause went to the master by consent, without this issue being tried; it has now been tried and determined as a question of fact, arising upon conflicting testimony, by him. To review his decision upon it now would be a rehearing of it upon, in effect, an appeal; and more, it would be allowing the party to come back to the court for the trial of a question voluntarily taken from the court to the master. Such a course is not according to the well-settled practice in such cases. The parties have had a full trial and decision of the question by the master, after his attention had been directly called to its controlling importance in the views of the court. To disturb his conclusion would be a departure from the usual course, which the court would not be warranted in taking, and to which neither party would be entitled."

This decision was approved and followed in Smith *v.* Laundry Co., 19 F. 826, and Wooster *v.* Thornton, 26 F. 274.

So in Lockhart *v.* Horn, 3 Woods, 542, it was held that the presumptions are in favor of the findings of the master. They will not be disturbed unless shown to be erroneous.

3. (FIRST EXCEPTION.) In ruling that *complainant has not proved the existence of an established license fee.*

This is also negatively stated in the SECOND EXCEPTION:

"*In not ruling that complainant has proved an established license fee of* $1,000; and in *not reporting as being due from defendants* $1,000—with *proper interest*—for each furnace."

This also requires the consideration of the FOURTH EXCEPTION:

"In ruling that *complainant is entitled only to nominal damages*, and in *not ruling that he is entitled to a substantial recovery.*"

We will consider the questions thus propounded in the following order:

1. Complainant's *Royalties.*
2. The rule as to *Damages.*
3. The allowance of *Interest* thereon.

Complainant's Royalties.

Complainant claims to have had three successive rates of license fees: 1. From 1867 to January 1, 1874—$150 per foot across the boshes; 2. From January 1, 1874, to January 1, 1880—$100 per foot across the boshes; 3. After January 1, 1880—$1,000 per furnace, regardless of size.

Kerr (X. 6, 7, pp. 132, 133) admits the grant of a license to Laughlin & Co. in 1868 for $1,000 as an introductory experiment.

April 11, 1879, Asmus not only granted a license to the Edgar Thompson Co. for one furnace for $1,000, but agreed to license as many more as they pleased at the same rate. (Complainant's Ex. A, p. 135.)

Exhibit C, p. 131, shows that one other such license was granted April 11, 1880.

Exhibit E, p. 137, also shows a *third* furnace licensed under this agreement.

Exhibit I, p. 138, shows the grant of a license May 21, 1880, for one furnace at the regular rate of $1,000.

These—with Kerr's testimony, p. 130—show nineteen furnaces licensed at $1,000, four of which were under agreements prior to 1880.

The master is correct in reporting proof of seventeen furnaces licensed at $1,000 after the establishment of that rate.

The master also reports six furnaces settled for—*after suit*—at the rate of $1,000 each.

Such settlements cannot establish a license fee against strangers. (Westcott *v.* Rude, 19 Fed. Rep. 830.)

March 15, 1881, Asmus licensed four furnaces for the lump sum of $3,500 (Ex. D, pp. 136)—an average of $875 each.

By comparing Exhibits D, E, and F, pp. 136, 136, it will be seen that the royalty on three of these furnaces was at the rate of $833.33 each.

Eight furnaces, built between 1880 and 1884, were licensed at the rate of $666.67. (Kerr, p. 130.)

R. H. Coleman—under threat of suit—took a license in 1883, for four furnaces, at a lump sum of $1,500—an average of $375 each. (Hess, A. 5, p. 144; Deft's Ex. Coleman License, p. 145.)

Complainant discontinued suit against the Brocks—sued about the same time as these defendants—*paid the costs*, and licensed *two furnaces* for $1,000—an average of $500 each.

The minimum was reached in the Meilys' case (pp. 147, 148) when suit was discontinued, and a furnace licensed for $100; an exculpatory endorsement being made on the license, in view of the pending suits against this defendant.

The R. H. Coleman furnaces were in defendant's neighborhood; of about the same class, and using the same fuel and ores. The Coleman furnace, however, was

worked with a water-cooled cinder-block of small aperture—and thus embodied some claims of complainant's patent—not infringed by this defendant. (Asmus, A. 60, 61, p. 25.)

The excuse for some of these reductions was the simultaneous grant of several licenses; but, as the master reports, suits were discontinued on some cases, and in others no excuse is offered. According to the master's report, there were 17 licenses regularly granted at $1,000; the above summary shows 18 granted at an average of less than $600 apiece.

It is worthy of notice that *the cheapest licenses were those granted in view of pending or threatened litigation.*

The master well says under these circumstances:

"'A royalty to be binding on a stranger to the licenses which established it, must be a uniform royalty.' (Walker on Patents, 390.)

"'No price can be said to be fixed, or royalty established, when the patentee varies his price according to the courage or the ability to resist of the infringer, or where there are other circumstances showing the absence of a fixed established fee.' Black *v.* Munson, 2 Ban. & Ard. 636; Wescott *v.* Rude, 19 Fed. Rep. 833. * * *

"Under the cases cited, the master is unable to find that the complainant has proved an established uniform license fee, and he is not of opinion that it is within the province of a master to find any one of a number of varying rates of license fees accepted by a complainant, or to find any intermediate sum, as a proper license fee.

"Complainant has, under varying circumstances, accepted various license fees. In the opinion of the master, any license fee found by him to be an established license fee must be one which has been uniform and one which the owner of the patent has established and received 'in his dealings with others.' Wescott *v.* Rude, *supra.*

"For the reasons stated, the master finds that the *complainant is entitled only to nominal damages of six cents.*"

The Scope of Complainant's License.

Complainant granted to all his licensees the right to use all the improvements claimed in his patent during

his whole term for the sums respectively named therein. (See Complainant's Exhibit A, p. 135. Also Complainant's Exhibit D, p. 136.)

Defendant is charged with infringing *features covered by one only of complainant's claims*, and that *for a limited period only*. Under this state of facts we shall contend that complainant's alleged established license fee demanded of this defendant must be reduced *pro rata:*

First. In the proportion their alleged infringement bears in point of time to the total length of the term of the patent.

Second. In the proportion that the license fee for the use of all the claims bears to the use of the single claim decided to be infringed by her.

Complainant has sought to evade this dilemma by calling three witnesses—Kennedy, Porter, and Schulze-Berge—to prove that some of Asmus' licensees in practice didn't control the flow of slag by regulating the temperature of the removable slag-discharge piece, the method of his seventh claim.

This testimony was objected to as immaterial, and the objection is insisted upon. The objection was made at the close of each deposition by agreement between counsel, instead of being interjected after each question.

Licensees were authorized to use every feature claimed in the patent, and the fact that in practice they didn't choose to use such and such features is clearly immaterial, except as showing want of value and utility in such features. The attempt is, of course, to lay the foundation for the inference that the water-cooled slag-discharge opening was the sole feature for which the license is granted; and yet these very witnesses prove the use—in addition to this feature—of a removable water-cooled slag-discharge piece, with means for controlling the flow of water through it, necessarily correspondingly varying its temperature.

Kennedy (X. 11, p. 139) says there were means for regulating the flow of water around the slag-discharge opening in all of the furnaces about which he testified.

Schulze-Berge, an interested and argumentative witness, admits on cross-examination (X. 17, 18, p. 141) that all the furnaces he visited were provided with apparatus having the capacity of increasing or diminishing the flow of water through the cinder-block, while the furnace was in operation. He undertook to say that these devices were not so used—though his visits to many of the furnaces only lasted one day. (X. 19, 20, p. 141.)

Porter (X. 19, p. 142) admits that the furnaces about which he testifies have means for changing the volume of water that circulates through the cinder-block.

Complainant apparently called these witnesses mainly with reference to the non-use of his seventh claim. One reason for this may have been that this was the important claim of the original patent—the first being interpolated in the reissue.

Lurmann, in his original patent, (granted after assignment to complainant,) having based his claims chiefly upon the removable cinder-block, and the method of controlling the slag-discharge, his assignee is now estopped from denying that these constitute a principal, or at least a substantial, part of the invention; that is to say, he cannot now be permitted to assert these to be mere subordinate parts of the invention.

The Rule as to Damages.

First. Full royalties cannot be exacted where a part only of the claims are infringed.

This doctrine is clearly enunciated in the Supreme Court cases of Seymour *v.* McCormick, 16 How. 486, and Birdsall *v.* Coolidge, 93 U. S. 64.

On this point the master reports:

"It is undoubtedly true that the general rule is that where less than the whole invention has been infringed,

evidence must be given to show the value of the part appropriated. Proctor *v.* Brill, 4 Fed. Rep. 415; Wooster *v.* Simonson, 16 Fed. Rep. 680.

"This general rule fails where the claim infringed is shown to be the only one of the several claims of the patent which has had any value, or where it is shown that the different claims of the patent are for substantially the same invention. Wescott *v.* Rude, 19 Fed. Rep. 830.

"It also fails in cases where the claims of the patent, other than the one or ones in regard to which the infringement has been decreed, are merely for devices or instrumentalities in which the invention specified in the claim or claims infringed may be embodied, or by the aid of which it may be practiced; that is to say, in cases where the claims are structural only. Williamantic Thread Co. *v.* Clark Thread Co., 27 Fed. Rep., p. 867; Cleon Tondeur *v.* Stewart, Estep & Co., No. 14, November term, 1885, Circuit Court of the United States for the Western District of Pennsylvania, (Manuscript decision.)"

In Wescott *v.* Rude, 19 Fed. Rep. 830, the court says:

"The question is, what is a reasonable royalty? The laws of the land fix the rates of interest for the forbearance of money, and if it be possible to make a discrimination against infringers of patents over prompt paying licenses greater than lawful interest, (except as may be done by the courts under the statutory provision for treble damages,) it must be done, as it seems to me, upon competent evidence other than an arbitrary clause in a license or licenses, however many of them may have been issued.

"The same may be said in reference to the clause in the license which requires that the specified royalty shall be paid for every drill 'containing any of the patented improvements.' This, as it seems to me, affords no proof, certainly not conclusive proof, against an infringer that he should pay the entire royalty named in the license for infringing only one of two or more claims of a patent, unless the one infringed be shown to be the only claim which has or had any value, or unless the different claims be substantially the same.

"In respect to two or more claims in a patent, each of value and distinct from the other, one cannot equal both or all in value any more than in mathematics a part can equal the whole. The licensee may, if he chooses, bind

himself to pay the same price, whether he use the entire invention or a part only; but at the same time he acquires the right to use all, and so his agreement may not be unreasonable; but if, as against an infringer, such a license can have any force, reasonably, it must be in the way only of establishing a royalty for the entire invention. This view is in accordance with authority.

"In Birdsall *v.* Coolidge, 93 U. S. 64, it appears that the alleged infringement was of one only of three claims in the letters-patent, and the court says: 'Still it is obvious that there cannot be any one rule of damages prescribed which will apply in all cases, even when it is conceded that the finding must be limited to actual damages. * * * Where the patented improvement has been used only to a limited extent and for a short time * * * the jury should find less than the amount of the license fee.' See, also, Proctor *v.* Brill, *supra;* Wooster *v.* Simonson, 16 Fed. Rep. 680; Ruggles *v.* Eddy, 2 Ban. & A. 627."

In the Williamantic Thread Case, 27 Fed. Rep. 867, 868, the court says:

"It was the duty of the master to ascertain the relative value of the different claims, as nearly as the nature and circumstances of the case allowed, and to charge the defendant for the use of the first and third claims such proportion of the whole license fee as the testimony revealed they were relatively worth in their contribution to the efficiency of the whole machine. The burden of proof was upon the complainants, who accepted it, and offered evidence before the master designed and tending to show that the first and third claims embraced the vital mechanism of the invention; that the second, fourth, and fifth claims were merely structural, indicating only certain specific forms within which the invention could be worked; and that the sixth claim related to the organization of instrumentalities which enabled the machine to stop in case the thread-winding on the spool became broken, and worked independently of the other claims, and was to be credited with such proportion of the license fee as its contribution to the value of the whole mechanism of the invention was proved to be worth.

"The master, in considering the testimony taken on the accounting, adopted the license fee for the whole machine as the fair measure of damages, followed what seemed to be the decision of the Supreme Court in affirming the

Court of Claims in the case of McKeever *v.* U. S., 14 Ct. Cl. 398, and recognized that he must make reasonable deductions for the relative value of the unused claims. He has reported that the second, fourth, and fifth claims were in fact only structural, and were comprehended within the mode of operation of the first claim, and that they should be regarded only as indications of particular methods for carrying out the invention; and that, on the other hand, the sixth claim, which acted independently of the first, should be credited with 6 per cent. of the whole amount that would have been due and receivable if license fees had been regularly paid at the rate of one-half of one per cent. per dozen for every dozen spools containing 200 yards each.

"Without taking up the consideration of the exceptions *seriatim*, it is only necessary to observe that I have examined the evidence in the accounting record with care; that the wide discrepancy of views of the learned counsel arises from the different theories insisted upon by them on which the master should have proceeded; and that so far as I find any rule for estimating the damages in such a case, I think the master has followed the one suggested or approved of by the Supreme Court in the above-quoted case.

"The result, therefore, is that the exceptions to the report must be overruled; and it is so ordered."

In this case it will be observed the royalty was based on the *product*, and not on the machine. One claim covered means of stopping the machine when the thread broke, which was not used by defendant, consequently its value was deducted from the royalty *pro rata*.

We were, it should be remembered, originally sued on the sixth claim as well as the first, the charge as to the sixth claim only being abandoned at the hearing.

This court has already held in this case that the device for regulating the flow of molten slag seems to be a distinct element or part of the invention.

On this branch of the case the master reports:

[16.] "Claim 7 of the patent in suit is for a method of controlling the discharge of slag from blast furnaces by regulating the temperature of the slag-discharge piece or

cinder-block. No evidence has been offered by the parties as to the value of the invention specified in this claim, or as to the existence of any separate established royalty or license fee therefor. It is admitted by the counsel for the responsive parties that the practice of the method of this claim could only be effected by the use of the invention specified in claim 1 of the patent and by the consequent infringement thereof.

[17.] "It is in evidence on the part of the complainant that a large number of licensees under the patent, in the use of the invention of claim 1, do not employ the method specified in claim 7. There is no evidence in the case before the master of the use of the method of claim 7 by any one.

[18.] "It was admitted by their counsel, in argument before the master, that the respondents did not regard the method of claim 7 as being of any practical value, and *that had they so regarded it they would have adopted and practiced it.*

[19.] "The master deems it proper to report these facts, but in consequence of the view taken by him of the question of an established royalty or license fee, he does not deem it necessary to decide whether any part of an established license fee under the whole patent should or should not be attributed and credited to the method forming the subject of said claim 7."

The italicized portion of paragraph 18 is obviously based on a misapprehension.

It would not only have been inconsistent for respondent, while denying infringement, to admit that she would have used that which was distinctly covered by the patent, and which they contended was the essence of the invention, but such an admission was entirely unnecessary for any purpose of the argument. The use of such a device is impracticable and irreconcilable with defendant's apparatus, and his proof was largely directed to that point; such an admission would have practically involved, not only a stultification, but a repudiation of both the testimony and previous argument for respondent. We are therefore reluctantly compelled to take

issue with the master on this matter, and to deny having made, or intended to make, any such statement.

The *opinion* in Tondeur *v.* Stewart in terms only decides that complainant could not have an increased royalty for a larger furnace. The master's report, and the exceptions thereto, discuss the questions of infringing a part only of the claim for a limited time.

The claims not infringed were, as we understand it, for sub-combinations of the devices infringed, and were held to be structural.

As elsewhere remarked, we do not understand how this case and that of Stutz *v.* Armstrong can be reconciled with the Supreme Court cases cited by us. The question is, which set of decisions will control this court.

Birdsall *v.* Coolidge decides that a full license fee cannot be exacted when a part only of the claims are infringed; following Seymour *v.* McCormick, 16 How. 484; Philp *v.* Nock, 17 Wall. 460–462. These decisions have often been followed in the Circuit Courts.

Kendrick *v.* Emmons, 15 O. G. 966, apparently ignores these decisions and decides the other way; but such decisions, it is submitted, cannot overrule a line of Supreme Court decisions.

In Shillinger *v.* Gunther, 15 Blatch. 303–315, no established license fee being proved, profits were disallowed on the authority of numerous cases cited, including Philp *v.* Nock.

This decision was followed in Fisher *v.* Hayes, 22 F. 529, which also held—as in Shillinger *v.* Gunther—that the accounting must be confined to profits received by defendant as a direct result of the use of that part of the invention specified in the decree as infringed, citing Mowry *v.* Whitney and Littlefield *v.* Perry, heretofore mentioned.

Second.—The full license fee cannot be exacted for an infringement limited in duration and extent.

In Birdsall *v.* Coolidge, 93 U. S. pp. 64–70, the court says:

"Frequent cases arise where proof of an established royalty furnishes a pretty safe guide for the instructions of the court and the finding of the jury. Reported cases of undoubted authority may be referred to which support this proposition; and yet it is believed to be good law, that the rule cannot be applied without qualification, where the patented improvement had been used only to a limited extent and for a short time, but that in such a case the jury should find less than the amount of the license fee. * * *

"Evidence of an established royalty will undoubtedly furnish the true measure of damages in an action at law, where the unlawful acts consist in making and selling the patented improvment, or in the extensive and protracted use of the same, without palliation or excuse; but where the use is a limited one, and for a brief period, as in the case before the court, it is error to apply the rule arbitrarily and without any qualification. Packet Co. *v.* Sickles, 19 Wall. 617; Burdell et al. *v.* Denig et al., 92 U. S. 716; Suffolk Co. *v.* Hayden, 3 Wall. 325."

This language was reiterated on the circuit by Justice Clifford in Judson *v.* Bradford, 16 O. G. 171; 3 Ban. & Ard. 539.

The following contrary cases were cited for complainant before the master:

Emerson *v.* Simm, 6 Fish. 281. A decree *pro confesso* was taken; the court awarded the established license fee for a limited infringement.

Stutz *v.* Armstrong, 25 Fed. Rep. 147, Acheson, J., held that the full license fee should be charged against deliberate, wilful, and prolonged infringement by licensees—not working under their own patent—who built infringing machines outside of their license. He distinguishes this case from that of Birdsall *v.* Coolidge by the above facts. Attention is called to the fact that the payment of the damages in effect grants a license to use the patent for the remainder of the term between 1882—the date of the patent—and that of his decision.

In Tondeur *v.* Stewart, W. D. Pa. (MS.), the master reported that seventeen licenses had been granted at $1,000 each—the only smaller one having been that for an introductory experiment. The patentee did not gauge his demands by defendant's ability to resist threatened suits. The damages gave a license to use the patent for fully two-thirds of its term in this case also.

These decisions, moreover, it is submitted, are not easily reconciled with those of the Supreme Court above cited.

The Allowance of Interest.

Complainant demands "proper interest," but specifies no time when, in his opinion, it should begin to run.

This necessitates an examination of the authorities on this point.

The Supreme Court decisions all tend one way—against its allowance prior to final decree.

Silsby *v.* Foote, 20 How. 386, reversed the court below on the ground of error in allowing interest.

Mowry *v.* Whitney, 14 Wall. 620, decided that interest on the amount found by the master is not allowable except in special cases.

This case was cited, approved, and followed in Littlefield *v.* Perry, 21 Wall. 205–229, which was an aggravated case of infringement by the patentee himself of his own license.

In Parks *v.* Booth, 102 U. S. 96–106, the court followed Silsby *v.* Foote, holding that "interest on the profits decreed to the complainant should not have been allowed, as was decided by this court many years ago, the better opinion being that profits in such a case are to be regarded in the light of unliquidated damages, which usually do not draw interest without the special order of the court."

These cases are cited and approved in Illinois Central Railroad Co. *v.* Turrill, 110 U. S. 301–303, which came within the exceptions specified in them, as the Supreme

Court had already decreed interest to be allowed from the date of its decree.

Mr. Walker, in his work on Patents, secs. 734–736, written before the decision in 110 U. S. above cited, dissents from this view on the ground that the Supreme Court, in Root *v.* Railway, 105 U. S. 214, held infringers to be trustees of the patentee, and then proceeds to consider how such trustees are so regarded.

The strict rule in such cases, it is submitted, is not applicable to the case of defendants working under a patent of their own, as in our case, and thus endowed by the government with a *prima facie* right to use their apparatus. Corning *v.* Burden, 15 How. 252; Livingston *v.* Woodworth, 15 How. 546–560; Mowry *v.* Whitney, 14 Wall. 620–653.

The Steam Stone Cutter Co. *v.* The Windsor Mfg. Co., 17 Blatch. 24–34, treats of this trusteeship question, discusses the cases of Silsby *v.* Foote, Mowry *v.* Whitney, and Littlefield *v.* Perry, and concludes by awarding interest from the date of the decree, which was the time defendants, who were working under a patent, were held to have acquired knowledge of complainants' rights. The facts of this case resemble those in the case at bar in many respects, but differ in that, in our case, the master has reported nominal damages only, while in the case above cited heavy damages had been reported.

In Brady *v.* Atlantic Works, 3 Ban. & Ard. 577–579, Judge Clifford held that argument upon the question of interest on profits was unnecessary, as the question was definitely settled against its allowance by the decisions of the Supreme Court, citing Silsby *v.* Foote, Mowry *v.* Whitney, and Littlefield *v.* Perry.

These concurring views of the Supreme and Circuit Courts, it is submitted, outweigh the criticism of a text-writer, smarting under his defeat as counsel in the case relied upon by him as the basis of an argument for the

evasion of an unwelcome decision, or rather series of decisions, by the court of last resort.

There are, it is true, conflicting decisions in earlier cases at the circuit, but it is believed no decision has been rendered on due consideration since the promulgation of that in the Illinois Central Railroad *v.* Turrill, 110 U. S., in contravention of the doctrine there ennunciated.

Under no circumstances, it is submitted, can complainant demand interest until after the decree in this case.

In Sickels *v* Borden, 3 Blatch. 535, Nelson, J., charged that an established license fee, with interest, was the proper measure of damages, but did not say from what date it was to be computed.

Birdsall *v.* Collidge was followed as to the established license fee in Locomotive Engine Safety Truck Co. *v.* Pennsylvania Railroad Co., 5 B. & A. 514–519, but allowed interest on the royalties from the date of infringement on the grounds: 1. That the amount of the royalty was fixed, and that, therefore, interest was only compensation for the delay of payment of a liquidated sum; 2. *No exception was specifically filed to the allowance of interest by the master.*

These two facts discriminate between our case and this in which no established license fee has been found to have been proved, and no interest allowed.

The decision as to interest directly contravenes Littlefield *v.* Perry, 21 Wall. 205–229, which reversed a decree awarding interest under aggravated circumstances.

Complainant did not present the question of interest on the argument below, and the court held it open to doubt. (p. 151.)

Recapitulation.

1. Lurmann's patent ran for seventeen years, and contained seven claims.

2. His licensees were entitled to use the subject-matter of all these claims during this entire period.

3. Proof that all the features were not used is immaterial, as the licensees could have used them if they desired.

4. License fees of $375 and $500 respectively have been accepted by complainant under circumstances corresponding with those of the defendant.

5. Defendants, having used one-seventh of the claims for one-fourth of the period of the patent, are entitled to a corresponding reduction of the alleged established license fee.

6. Robert H. Coleman used the water-cooled removable cinder-block—which defendant does not—as well, as the features covered by the first claim. (Asmus, Ans. 61, p. 26.) He was licensed to use four furnaces for $1,500.

7. *Complainant having failed to show any established license fee for the alleged use of the subject-matter of the first claim, is entitled to nominal damages only. The master so reports, and his report should be confirmed.*

The appeal should be sustained; the decree below reversed, and the reissue declared void, or, at least, not infringed.

WAYNE MacVEAGH,
WM. D. BALDWIN,
Counsel for Appellants.

WASHINGTON, D. C., *April* 12, 1892.

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SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1891.

TERM No. 323.

MARGARET C. FREEMAN, APPELLANT,

vs.

GEORGE ASMUS.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE EASTERN DISTRICT OF PENNSYLVANIA.

BRIEF FOR APPELLEE.

WILLIAM BAKEWELL,
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RECORD, CASE NO. 13,482.

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BRIEF FOR APPELLEE.

Accepting as correct the statement of the case and the abstract of the pleadings contained on pages 1 to 14 of

NOTE. The references throughout are to the printed record herein, unless otherwise stated.

appellant's brief, we shall confine our brief to the consideration of five principal points viz.:

1. The nature, scope and patentability of the invention.
2. Infringement.
3. Alleged anticipations.
4. Validity of the reissue.
5. Damages.

Nature, Scope and Patentability of the Invention.

The Prior or Open-Front Furnace.

The invention is stated in the patent (see original Patent, p. 82, and reissue, p. 85) to be an improvement in blast furnaces. A blast furnace is a well-known structure, consisting of a hollow cylinder, or cylindroid, of irregular internal diameter, built of stone or brick, and lined with fire-brick or other highly refractory material. The modern blast furnaces vary in height from 50 to 100 feet, and in diameter at the boshes (or widest part) from 15 to 30 feet or more. They are smallest at the lower end (called the hearth), and are usually closed at the top by a removable cover or lid; and have small openings at the sides for the admission of the tuyeres or blast pipe nozzles. Between the tuyeres and the hearth in blast furnaces of ordinary construction is the "fore-hearth," or, as it is sometimes called, the "tymp," which is a comparatively large opening at one side of the furnace through which the furnace is "worked." This fore-hearth projects beyond the circumference of the interior and extends down to the hearth. It is covered over at the top by a horizontal or nearly horizontal metallic plate, called a weight plate, which is removable, and is closed in front by a vertical metallic plate, called a dam plate, which has an opening leading into the furnace for the outflow of the molten metal. The inner face of the dam plate is protected by the dam, which is composed partly of masonry and partly of

clay packed in to stop the opening of the fore-hearth, but through which a passage may be made with a crow-bar to allow the metal to flow at stated intervals—say, once in eight hours.

The charge of a blast furnace consists of iron ore, carbon in some form, either charcoal, anthracite coal, or the coke of bituminous coal, and limestone, which is used as a flux. The iron ore being an oxide is reduced by means of the carbon uniting with the oxygen and also with the iron, and thus setting the iron free from its union with oxygen. The limestone melts and unites with the earthy and other impurities of the iron ore, forming what is known as cinder, which runs down into the hearth and, being lighter than the melted iron, floats on top of the same. It is waste material, and tends to clog the furnace, and must therefore be got rid of. Whenever it rises nearly to the level of the tuyeres, or blast pipes, it has to be removed by running it off at a point above the level of the fused iron. This operation, which is called "tapping the cinder," is done several times in the intervals between the iron tapping. The use of a fore-hearth necessitated the performance once or twice a day of a difficult, laborious and disagreeable operation known as "working the furnace," which is described by Grittinger, the defendants' inventor and manager, as follows (p. 55):

> "The working of the furnace consisted in the removal of the effete or dead matter that accumulated in the fore-hearth, by forcing the same upward with a light blast pressure and then shoveling it off. It was also necessary at times to loosen the material by means of wringers and crust bars which were inserted in the fore-hearth. It *frequently happened* that the slag and effete matter in the fore-hearth became chilled up and could be removed only with difficulty."

The fore-hearth is an opening in the lower part of the hearth, about three feet wide, and extending outwards usually from four to six feet; and being removed at some distance from the interior of the furnace, where the smelting operation is

going on, it is comparatively cool. The furnace wall of this opening extends to the level of the outer edge of the fore-hearth, thus forming a trap, on the "bird-fountain" principle, and the lower edge of the wall of the furnace at the opening has a stopper of clay placed in it, to protect the wall from the cutting action of the slag, which contains much unreduced iron and has a powerful effect on the lining of the furnace. Into this bay, formed by the fore-hearth, floats with the cinder, some coal and unreduced iron, and the refractory material introduced with the fuel and forms a hard mass called a chill. This has to be pierced through in order to reach the fluid cinder and the molten iron. This mass or crust of partially chilled materials has to be dug out daily, as otherwise the chill would extend into the hearth of the furnace, forming what is called a "salamander," which entirely stops the operation of the furnace, and can only be removed by tearing down the walls.

The loss of time caused by this "working the furnace," or removing the accumulated mass from the fore-hearth, requires the blast to be stopped and the smelting operation suspended from two to four hours out of every twenty-four (p. 117).

Mr. Asmus (p. 12, Int. 7) produces a sketch illustrating the construction of an open-front furnace, which is marked "Exhibit Asmus Sketch No. 2," and is page 77 of the original record. In this sketch A indicates the hearth, B the tymp plate, C the stopper of clay placed below the tymp plate, D the dam, E the iron tap and the portion between C and D the fore-hearth. Mr. Asmus says the fore-hearth is marked F, but the letter of reference is omitted from the drawing.

A similar construction is illustrated in "Defendant's Exhibit Grittinger Sketch No. 1" (p. 116), with the difference that the fore-hearth is covered by a heavy iron plate known as the weight plate, which is held in place by a prop inserted under one of the lintels of the furnace. This sketch shows the construction of the defendant's furnace before it was

so changed as to infringe the patent. A like construction is also shown in defendant's extract from Percy's Metallurgy (p. 105), and also in the Bryant Patent (p. 111).

Mr. Asmus (p. 12) thus describes the objections to the old open-front construction :

Int. 8. You speak about a loss of time in the tapping of cinder in furnaces of the open-front construction. Please state what are the causes of that loss and what its effect is in the production of the furnace ?

Ans. The loss of time in keeping the fore-hearth in repair differs with different furnaces using different material, but on an average it amounts to two or three hours of time out of twenty-four. During the repair the blast has to be taken off, and no iron is made during that time. The hot blast cools off because no gas is produced during that time, and, after the blast is let on again, colder air as before is blown into the furnace, which also decreases the output, not only the output, but at the same time the quality of the iron produced ; that is to say, a furnace fitted for working correctly with a certain degree of heat in its blast cannot be disturbed in this respect without damaging the product.

Int. 9. State what effect, if any, the furnace has on its fuel during the time that its blast is taken off ?

Ans. There is air passing through the furnace by the open front, burning fuel slowly and doing no smelting ; so a loss of fuel is the consequence.

Int. 10. You have spoken about a great deal of labor being required in the working of a furnace with an open front. Please state what that labor is and what causes the necessity for it ?

Ans. As not only the cinder but also the iron is discharged through the fore-hearth, it is necessary to keep the same always in such a condition that the iron discharge can be easily accomplished. The fore-hearth, being a comparatively cold outside part of the hearth proper, is always filled with half-smolten clay and with half-smolten ore and unconsumed fuel mixed up with iron. This conglomerate of substances, being out of the reach of the blast, has to be removed frequently, else it will form a tough mass, which cannot be broken into for letting out the iron, and it is this cleaning out which has to be done in most cases every time the iron is tapped, which causes much loss of time and the very hardest labor the furnace men were subjected to. With a closed front all this is done away with entirely. The iron is tapped by a short cut directly from the hearth, and so is the cinder.

See also Asmus' testimony in rebuttal, pp. 23, 24, Ints. 37–52.

Robert C. Porter, a blast furnace manager since 1866 (p. 33), first operated an open-front furnace.

Int. 4. Did you ever have the fore-hearth fill up?

A. Yes.

Int. 5. What was the effect of that chilling upon the work of tapping the iron?

A. It interfered with the tapping of the iron and made trouble; it made delay in drilling for the iron.

Int. 6. Could the furnace be run right along during such delay?

A. It frequently happened when we had the open fronts that with a chill in the hearth or crucible that we cast over the dam, and in that way continued to run the furnace.

Int. 7. Could you continue to use the furnace without cleaning out the fore-hearth, by casting over the dam?

A. We could continue to use the furnace, but we considered the furnace in very bad shape when we were compelled to cast over the dam.

Int. 8. What was necessary to be done to remedy it?

A. We always made it a point to either cut out the hearth, if possible, and if we could not succeed in cutting out the hearth to blow out the furnace.

Blowing out the furnace means to put out the fire and discontinue its use.

Ignatius Hahn (p. 35), an engineer and metallurgist, skilled in the construction and operation of blast furnaces, testifies as follows (p. 36):

Int. 7. What advantage, if any, is there in the Lürmann furnace over the old open-front furnace?

Ans. In the open-front furnace, owing to the frequent necessity of removing the cinder through those large openings from the fore hearth, the interior becomes more cool, and, in consequence thereof, leads to more frequent accumulations, to remove which the dam plate must frequently be opened for working out those obstructions, during which working the blast in all cases must at least be slackened and mostly even stopped for a great length of time until the hearth is cleaned again. In consequence of such slackening or stoppage of the blast, combustion is interrupted in the interior of the furnace, whereby a larger part of the furnace becomes considerably cooled and absorbs a greater quantity of fuel and time to subsequently restore the same heat at which the furnace works best and which existed before commencing cleaning. Thus, it is safe to say that not only the time actually absorbed in working—that is, cleaning out, the fore hearth is lost, but as much again until

the furnace comes again to that temperature that existed before. Again, frequently it occurs that the flame and blast passing out through underneath the tymp further reduce the heat in the furnace and annoy attendants by the heat of the flame and the usual bad smell of the gases issuing from the furnace. A further disadvantage of this arrangement consists in the rapid destruction of the tymp and wall stone, the renewal of which again absorbs time and retards the operation of the furnace.

The Lürmann Invention.

This was the condition of things when Mr. Lürmann made his invention. His idea was that the fore-hearth was used for the purpose of getting rid of the cinder, and that it had nothing to do with the smelting process, which it only served to hinder, as it involved an unnecessarily large opening into the furnace, prevented the uniform distribution of the blast tuyeres, compelled the frequent stoppage of the blast, during which time the fuel was wasting away while the smelting operation was suspended, and involved a large amount of labor and the wear and tear of tools in digging out the fore-hearth. He therefore removed the fore-hearth entirely, closing up the opening which its presence necessitated, and making the openings for the discharge of cinder and the tapping of the iron directly into the body of the furnace. In short, he did away with the old "open-front" furnace with all its troubles, and substituted therefor what is known as the "closed front" or "closed-breast" furnace. By this arrangement all the difficulties before mentioned are overcome, and the cinder, being drawn from the body of the furnace where everything is hot, is more fluid and runs more readily out of the hole or cinder notch made for that purpose. The invention consists in the peculiar construction of the furnace, which is called in the reissue a *closed-breast* furnace, for the reason that instead of having a *tymp* or *fore-hearth* projecting outwards from the circumference of the inner surface of the furnace through which to discharge the cinder, the interior

surface of the furnace is built uniformly all round, and a notch or opening is made at the proper height for the escape of the cinder, which notch or opening is cooled with water to prevent the cutting action of the cinder on the surface of the passage. The patent also claims a metallic nozzle which is also water-cooled, and is called a "slag discharge piece," or "cinder block;" and also a *method* of controlling the discharge of slag from the furnace, when the cinder block is used, by regulating the temperature of the cinder block through which the cinder flows.

The first claim of the reissue is for "a blast furnace with "a closed breast, where the slag is discharged through an "opening or openings cooled by water, substantially as set "forth."

The succeeding four claims, Nos. 2 to 5, all have reference to the cinder block or slag discharge piece; the sixth claim is for the water-cooled plate, which supports the cinder block, and the seventh claim is for the *method* of controlling the discharge of the slag before referred to.

The Advantages of the Invention.

In the original patent the invention referring to the old open-front arrangement (p. 86) says:

"This method of construction has several disadvantages, one of which is the difficulty of keeping the tymp stone and the surrounding parts in repair; another is, that the pressure of the currents of air or wind is limited and counteracted by the counter-pressure of the column of slag in the tymp; and another is, that one side of the furnace being occupied by the tymp, no tuyere can be applied on that side, and consequently the supply of wind is irregularly distributed."

The same statement is contained in the reissue, except that the words "and counteracted" are omitted and "fore-hearth" is substituted for "tymp."

Referring to his improvement the inventor says (p. 81):

The invention is attended with several advantages over

the common method of constructing or arranging furnaces among which I will mention the following:

"FIRST. It permits a higher pressure of wind.

"SECOND. The hearth is preserved in better condition than where the common mode of construction is retained.

"THIRD. The labor of the operation of smelting is lessened.

"FOURTH. It allows one more side of the hearth for a tuyere.

"FIFTH. It avoids the stoppages of the wind supply, now necessary as often as the iron is discharged.

"SIXTH. A considerable increase is gained in the product of the furnace, while at the same time the cost of labor and repairs is lessened."

The inventor also says (p. 84):

"This invention can be easily applied by those skilled in the art to which it belongs, to blast furnaces of the common construction, by removing the fore hearth and closing the aperture left in the breast of the furnace, under the tymp stone, by inserting the plate C with the cinder block D."

These statements from the patent are fully supported by the testimony in the case.

Mr. Asmus (p. 13) says:

"Int. 11. Please state any advantages that occur to you in the used of the closed front or Lürmann system over the prior open front construction?

"Ans. There is one advantage in the construction itself. The hearth, having no outside projection, becomes stronger by being held together like a barrel with hoops. The main advantages are in the fact that a closed front furnace runs all the time under full pressure, not necessitating any repairs concerning the cinder discharge and not needing hard work done by skilled labor about the front parts, which are the weakest in open front furnaces, while it is just as strong as any part of the hearth as soon as the closed front system is adopted.

"Int. 12. State what, if any, effect it has upon the output of the furnace and upon the amount of fuel used?

"Ans. The effect as to output and saving of fuel is very different with different furnaces. Whenever a large amount of cinder is made in consequence of lean ores the destructive effect of the cinder outflow is greater than where rich ores are smelted. At an average, I find that a saving of a least ten per cent. of fuel and more output of twenty per cent. of iron is effected by changing from the open hearth system to that of the closed front. I have known of some instances where the output was doubled by making the change."

Ignatius Hahn (p. 37), in connection with his answer 7, which has already been cited in showing the disadvantages of the old open-front construction, says:

"Inasmuch as Lürman's invention dispenses with tymp, fore-hearth and the dam-stone, all the disadvantages enumerated before as existing in the old-style furnace with fore-hearth are readily overcome, and as a result thereof the production of the furnace is considerably increased, the labor less tiresome, and a greatly reduced amount of repairs, as all parts have a longer duration and no heat lost. The furnace works better and more regularly."

Meaning of the terms "tymp" and "tymp-stone," as used in the patent.

In the original patent it is stated (p. 85) that the

"invention relates to furnaces for smelting iron ore and has for its object to dispense with the 'tymp' or fore-hearth and the 'wall stone' now in common use in iron blast furnaces, and to replace the tymp arrangement by such a construction as allows the slag to be tapped directly from the hearth."

It is necessary to notice that the inventor in the original patent uses the word "tymp" as having the same signification as "fore-hearth," as in the foregoing quotation, and hence he says further on, "My furnace has no tymp, and the sides of the hearth, whether round or square, extend clear down to the bottom;" whereas the defendant's witnesses use the word "tymp" in a more restricted sense to mean that part which is called in the patent the "tymp stone;" for the inventor in speaking of the old construction of furnaces, says:

"In the tymp arrangement the slag is driven out of the furnace by being first forced below the *tymp stone*, which projects below the level of the tuyeres and intercepts the currents of air, and prevents their escape with the slag which stands *in the tymp* at the same level as on the hearth, the slag being discharged only when it rises in the tymp high enough to overflow the top of the wall stone that forms the bottom of the discharging orifice. By this arrangement the *tymp stone* constitutes *a trap*, which intercepts the currents of air and causes their pressure to be exerted directly on the surface of the slag in the hearth."

The different use of the terms "tymp" and "tymp stone" in the original patent and by the defendant's witnesses would be unimportant were it not that a right application of the terms materially effects the question of infringement as raised by the defendants. In the reissue the term "fore-hearth," which is more usual in this country, is generally substituted for "tymp," thus rendering the specification more intelligible.

Water Cooling of the Slag Discharge Opening.

The next point of importance is the water-cooling of the slag discharge opening. As the slag is drawn directly from the hearth of the furnace by the Lürmann construction it is much hotter, and the walls of the orifice could not withstand the cutting action of the hot slag, unless such provisions were made. The specification describes the plate C and the piece D as both being cooled by forcing water through them; the piece D being the removable slag nozzle before mentioned, and the plate C being placed around the opening in the wall of the furnace in which the piece D is placed, and which itself forms the slag discharge orifice, when the piece D is removed, as the specification says it may be.

The first claim of the reissue in suit (which is claimed to be infringed by the defendant) is as follows:

"*First.* A blast furnace with a closed breast, where the slag is discharged through an opening or openings cooled by water, substantially as set forth."

This claim is intended to cover a blast furnace which has no fore-hearth, but instead of that the walls of the furnace are substantially the same all around the hearth, and in which provision is made for the discharge of the slag by an opening *directly* into the hearth or body of the furnace, such opening being cooled by water, *and this, whether the cinder block described in the specification be used or not.*

In the specification of the patent (p. 86), the plate C to

which the removable cinder block D is secured is described as a stationary iron plate,

"cast or made with channels or pipes running through it, and the channels or pipes of said plate and of the cinder block D may be so arranged as to connect or communicate with each other, when the plate C and cinder block D are in proper position, or they may be independent of each other. In the drawing, the plate C is shown above the cinder block, but it may be placed below, or in any other position in relation thereto."

The plate C is placed over the opening in the wall of the furnace made for the slag discharge, and, being water-cooled by channels or pipes running through it, forms a water-cooled slag discharge opening when the cinder block D is removed, and serves to hold the cinder block in place when it is employed.

This plate C is not a "tymp" nor a "tymp plate," in the sense used in the patent, for the obvious reasons given by Ignatius Hahn, who says (p. 38, Int. 19):

"It cannot be called a tymp plate, because there is no tymp, which only exists in connection with a fore-hearth. The principal invention of Lürmann is to dispense with tymp and fore-hearth, and apply instead thereof a water-cooled opening for removal of the cinder and occasionally also obstructions."

In the old construction of blast furnaces with a fore-hearth the *tymp stone* projected down from the furnace wall below the level of the top of the wall stone (or outer stone) of the fore-hearth, forming a trap; but there being no such device as a fore-hearth or trap in the Lürmann blast furnace, there can be no tymp. The fact that some of defendants' witnesses call that part of the wall in a closed-breast furnace a "tymp" cannot alter this fact.

The Introduction of the Invention.

Mr. Asmus (p. 14, Int. 22) states that the improvement has been adopted in a great many furnaces, and he gives a list of

fifty two of the largest iron and steel manufacturing companies in the United States who have adopted it and taken license under the patent. This introduction, however, was not secured without labor and trouble on the part of the appellee, Mr. Asmus. He testifies in reference to it (p. 27) as follows:

"Int. 73. What was your experience with reference to the introduction of the Lürmann invention.

"Ans. Most people laughed at it, and the difficulty to induce anybody to adopt the new plan was extremely great. The principal objection was that the stock which was shoveled out every day from the fore hearth could not be taken out any more, and the furnace was closed. This stock was considered by most furnace men infusible dead matter, which had to be removed. It was difficult to make them understand that it only became dead matter while shut up in the outside cold box called the fore hearth; that it was nothing but cold and half-smolten ore beyond the reach of the blast, becoming so in fact dead matter, which had to be removed. They could not see that if the furnace had no fore hearth everything that dropped down upon the surface of the molten iron would rise, would be under the influence of the smelting heat, and would either smelt or burn. So the furnace keeps itself clear—it becomes, in fact, self acting—and all the loss of time and fuel and the great amount of work is done away with as soon as the fore hearth is abandoned. A few of our leading blast-furnace men, however, saw the correctness of this argument. They allowed me to change their furnaces from the old to the new system, while in blast. In some instances they abandoned it again for a time because the workingmen were badly opposed to the new plan. In the Lehigh Valley, for instance, by old practice, all the coal shoveled out of the furnaces belonged to the furnace laborers, and they lost a great benefit as soon as the coal was allowed to burn up, for the purpose for which it was thrown into the funnel head. Still, some of the furnaces kept on working well, and little by little the truth found its way throughout, until now the revolution is a complete fact, undisputed by any of our leading blast-furnace men."

Mr. Julian Kennedy (p. 21) testifies as follows:

Int. 24. Please state how generally closed-breast furnaces having water-cooled cylinder outlet are in use in this country.

Ans. I think they are used in nine-tenths of what we call the better class of furnaces, making from eighty tons upward a day.

He personally knows of about forty furnaces making over eighty tons of iron a day (p. 22, Int. 38).

Mr. Robert C. Porter (p. 34) testifies:

Int. 13. Can you state upon what plan the leading furnaces of the country generally are built.

Ans. Closed-front furnaces in all the modern plants; that is, the best improved modern furnaces.

Int. 14. What kind of a cinder outlet have they.

Ans. They are not all alike, but the cinder outlet is protected by water.

Mr. Ignatius Hahn (p. 37) testifies as follows:

Int. 8. Are you familiar with the construction of any blast furnaces at the present time.

Ans. I am; and have repeatedly designed the latest improvements for blast furnaces for remodeling existing blast furnaces.

Int. 9. Please state what construction is in use in the furnaces known to you at present time.

Ans. The best style of furnaces now in use generally employ Lürmann's improvments, but there are still others which still adhere to the old fore hearth and its necessary tymp and wall stone.

Int. 11. What is the case with the larger furnaces known to you.

Ans. The largest and more economically working blast furnaces of the present day are supplied almost without exception with Lürmann's improvements.

Limitation of Claim.

The claim at issue in this case is the first claim of the patent, which is as follows:

"A blast furnace, with a closed breast, where the slag is discharged through an opening or openings cooled by water, substantially as set forth."

It will be noticed that this claim is not broadly for a closed-breast furnace, but is limited by its terms to such a furnace having a water-cooled cinder discharge opening. This is more a seeming than an actual limitation, for the reason that it is im-

possible to use a closed-breast blast furnace without a water-cooled cinder discharge opening.

In regard to this matter Mr. Asmus testifies (p. 13) as follows:

"Int. 14. You have spoken about closed front furnaces. Please state what construction, if any, of cinder discharge opening is used with such furnaces?

"Ans. In building the hearth an opening is left in the wall at the proper height, a foot or two below the tuyeres, through which the cinder is tapped directly from the hearth, and this opening is protected by water-cooled castings or water coils from being eaten away or enlarged.

"Int. 15. What effect, if any, would be produced by the tapping of the cinder in the absence of this provision for protecting the opening?

Ans. The brickwork of that part of the hearth where the cinder is discharged would be melted away by the cinder flowing through an unprotected opening.

Int. 16. State whether or not a closed breast furnace without such provision for protecting the wall at the cinder opening would be a practically useful and operative furnace.

Ans. Such a furnace would not be practicable for the reasons given before, especially where hot blast, high pressure and lean ores come together, all tending in their effects to destroy such an unprotected opening.

From the foregoing it will be seen that this improvement is one of great utility, that it was received with incredulity and introduced with difficulty, but that after it had been tested it worked a revolution in the art of blast furnace construction and practice. We know of no more fitting close to this section of our brief than the following quotation from the opinion of Judge BUTLER (p. 122):

"Did the patentee's improvement of the old furnace require invention? This question, I think, is free from doubt. What constitutes invention in the legal sense is difficult of exact definition in terms. Where, however, an old device or machine in general use, with acknowledged serious defects which have been long endured because no one has previously discovered a means of obviating them, is taken in hand, and by changing its form or structure they are removed and a different and greatly improved result obtained, it may safely be affirmed that the change required invention. Where the im-

provement and consequent public benefit is great, very little evidence of invention is required (*Smith vs. Goodyear Co.*, 93 U. S., 48; *Washburn vs. Manf. Co.*, 4 Fed. Rep., 907; *Essinger vs. Richey*, 14 Blatch., 307; *Isaacs vs. Abrams*, 14 O. G., 862). The advantages arising from the plaintiff's improved furnace are very great, as the record shows; among them, that it admits of a higher pressure of air, diminishes the labor attending the operation of smelting, increases the product while dimishing the cost, and lessening (if not avoiding) the danger of chilling. Indeed, so great are the advantages that it has virtually driven the old form of furnace out of use where the business of smelting is largely carried on."

Infringement.

The defendant in her answer denies infringement of complainant's patent, but adds:

"the only furnace used by her being constructed in substantial accordance with Letters Patent No. 209,119, granted October 22, 1876, to Henry C. Grittinger, the manager of this defendant's and her associates' works at Cornwall, Pa., with the exception of the omission of the water-cooling pipe in the weight plate and around the slag-discharge opening, the use of such water pipe having been for some time discontinued, this defendant not using any water-cooled arrangement to regulate or control the flow of slag through the furnace" (Answer, § X, p. 7).

Defendant's witness, Grittinger, patentee in the patent referred to in the answer, has testified as to the furnace used by defendant. He produces sketches marked Nos. 1, 2, 3 and 4 (p. 116), of which Nos. 1 and 2 show the construction used from 1875 to 1878, and Nos. 3 and 4, the infringing construction. This furnace was at first an open-front furnace, but owing to the difficulties incident to the use of the fore hearth it was changed to a closed-breast. After making several alterations mentioned by the witness (p. 56), he says:

"*We then had a new tymp made with a semi-circular opening*, as shown in sketches Nos. 3 and 4; * * * also attached to same a cast iron cinder block lined with fire brick, as shown in the sketches. We also placed a cast iron weight plate under the cinder block for the purpose of keeping it in place."

The witness then states that at first they circulated water through the plate and cinder block, but afterwards "the water-cooling pipe in same were abandoned" * * * "we, how-"ever, continued using circulating pipe in both the tymp and "the dam, which were the only water-cooled appliances we "*are* using in connection with our cinder flushing arrangement, "and this is done merely to protect the materials of which "they are composed."

This evidence will be more intelligible by referring to the Grittinger Patent (p. 49, *et seq.*) and comparing the same with the sketches referred to as introduced by the witness Grittinger.

Sketch No. 1 shows an open-front furnace having a fore-hearth, the dam plate being placed a considerable distance from the hearth or body of the furnace between the parts marked "fire-brick" and "water-cooled tymp," the latter parts constituting the trap. In this furnace the cinder was discharged throught the fore-hearth by punching a hole through the mass of chilled stuff lying between the "dam stone" and the "clay stopper," when the liquid cinder would pass out from the hearth by overflowing the upper edge of the "dam stone" and "dam."

In sketches Nos. 3 and 4 we have the witness' representation of the furnace as now used by the defendant. The part lying inside of the "water-cooled dam," and included in a curved line, is brick work (though not so marked in the sketches), and forms a downward continuation of the outside wall of the furnace. An opening is made in this wall, which is faced externally with a water-cooled plate having a semi-circular aperture, and marked in the sketch "water-cooled tymp." In front of this, and resting on the wall is an arched casting, which forms *an arched extension* of the part marked "water-cooled tymp," but is *not shown to have any function whatever*, although it may perhaps serve to prevent the upward splashing of the fluid cinder under the pressure of the blast within the furnace. The diameter of this opening is said by the

witness to be 14 by 14 inches, which they reduce by packing to 10 by 10 inches, and sometimes to 50 square inches, which would be about 7 by 7 inches, or, if circular, 8 inches diameter, and it is stopped with wet coal dust and clay.

Now by reference to the Grittinger Patent (p. 50) which defendant says she is using (with the exception before referred to), we find this device described as follows:

"I employ an attachment or device provided with a large opening (size not stated) attached to or inserted either in the side or fore part of the furnace, a little below the level of the tuyeres, said attachment consisting of a tymp or water-breast, which may be either separate from or combined with a water block or tuyere. * * * The tymp, water block or tuyere may be of metal or of fire clay, * * * and be suitably protected as may be required by means of a flow of cold water running through it, or through a coil of pipe enclosed in or encircling it in suitable well-known ways."

By reference to the model, "Defendant's Exhibit Cinder-Flush," which also represents the device, it will be seen that if the tunnel in front of "water-cooled tymp" be removed, *we have exactly the complainant's device of a closed-breast furnace with a water-cooled cinder discharge, opening directly into the hearth of the furnace.*

That this is so is further clear from the first claim of the Grittinger Patent, which is for the method of flushing the cinder *directly from the furnace* at intervals, &c.

The part of the defendant's furnace marked (in Grittinger' Sketches Nos. 3 and 4) "water-cooled tymp," is the part through which the fluid cinder passes directly from the furnace, and is therefore a water-cooled slag discharge opening within the meaning of the specification of complainant's patent and of the first claim. No size is specified in the Grittinger patent for this opening; it is simply called *large*, but we will see by reference to the testimony of Porter and Kennedy that the slag discharge opening used under the complainant's patent (when the cinder block is removed) is sometimes larger even than that which defendant is using.

The defendants' model "Cinder Flush" shows that the so-called "tymp" is water-cooled; *it is the tunnel in front of the "tymp," which* the witness Grittinger says *they have ceased to cool with water.* The water-cooled tymp remains, and it has practically the same shape and performs the same function as the water-cooled plate C of complainant's patent when the small cinder block D is removed.

Whether the defendants use the door attached to the tunnel in the Grittinger patent does not clearly appear, but whether or not, it is a mere addition to the Lürmann device, and is not in any way a sustitute for any part shown in the patent in suit.

It does not need citation of authorities to this Court to show that mere additions, whether improvements or not, will not avail to escape the charge of infringement.

Furthermore, it is a significant fact that the specification of the Grittinger Patent was drawn with full knowledge and recognition of the Lürmann Patent and its reissue, which had been issued ten years previously, and had meanwhile come into extensive use. Moreover, the first claim of defendants' patent is for "a method of flushing the cinder quickly from "the furnace at intervals, which consists in slackening the blast "and opening the flushing aperture, then throwing on the blast "and opening the flushing aperture, then throwing the blast on "to flush, and again slackening to admit of the closing of the "flushing aperture."

This shutting off of the blast when the flushing aperture is opened only to put it on again to force out the slag would seem to be useless, but the shutting off of the blast to close the enlarged opening is described by Porter and Kennedy, complainant's witnesses, as the mode of operation practiced with the Lürmann furnace when it is used without the removable cinder block (Kennedy, p. 20, Int. 18, and Porter, p. 34, Int. 22).

We have already alluded to the fact that the inventor,

Lürmann, in the original patent states that he dispenses with a "tymp," and, as we have seen, Grittinger, in his patent, calls the water-cooled metallic casting, through which the fluid cinder issues from the interior of the furnace, a "water-cooled tymp."

We can hardly suppose that this different use of the same word by Lürmann and by Grittinger will be used as an argument on the question of infringement. The question is not what terms are used by the two patentees, but what each of them means to describe by the words he employs. The water-cooled metallic plate D, shown in Grittinger's Patent, is the same thing in shape, location and function as the water-cooled plate C in the Lürmann original and Asmus reissue. In both it is the plate covering the opening through which the fluid cinder passes. Complainant's witnesses say that the defendant's plate D is not a tymp because there is no tymp in the defendant's furnaces nor in Grittinger's Patent—no tymp because there is no fore-hearth. As we have shown, Lürmann in his original patent used the word "tymp" to designate the fore-hearth of a blast furnace; his invention was to dispense with a fore-hearth, and therefore he says he dispenses with a "tymp." Grittinger's Patent and defendant's furnace also dispense with a fore-hearth, but by using the old term "tymp," to designate the water-cooled aperture for the cinder discharge, they cannot, we submit, thereby evade our patent and escape the charge of infringement. There is no authoritative evidence as to the correct use of the term tymp, and the only course which can be adopted in construing the patents and the testimony is to consider what meaning was attached to the word by the parties who used it.

The defendant's plate D, which they call a tymp, does not even resemble a tymp plate, which was a flat or angled metal plate, or shoe placed on the lower end of the tymp stone (see B on Asmus Sketch No. 2). On the contrary, defendant's so-called tymp D is a water-cooled metal plate *with a hole or arch*

in it through which the cinder passes. It is not a tymp plate, it is not fitted for use as a tymp plate and there never was a tymp plate like it. The only object in calling it a tymp is to deceive the Court as to its real character and purpose.

We submit that the infringement of the first claim of the reissue in suit is clearly established.

Defendant's Theory of Non-Infringement.

The defendant denies infringement upon a very curious theory, which is briefly as follows: That the Lürmann Patent is limited to discharging the slag in a very liquid form through a very small opening, that is, the opening in the cinder block D. It is argued that this is so, because the patent states that the flow of slag through the cinder block D may be regulated by varying the temperature of the cinder block by increasing or decreasing the flow of water through it, which method constitutes the subject matter of the seventh claim.

That, on the other hand, the defendant uses the method described in the Grittinger Patent, which consists in the use of a large cinder discharge opening and the flushing out through such large opening of the unfused matters or foreign solid substances which may accumulate in the furnace, and that this is a different construction and operation described in complainant's patent, and is not an infringement of the first claim.

Mr. Weimer, an expert for the appellant, says:

(P. 67) Q. 6. "Mr. Lürmann has a patented device for drawing the liquid cinder either in a constant flowing stream or at intervals. Mr. Grittinger also has a patented device for drawing away both the liquid cinder and foreign solid material at stated intervals."

"Q. 11 (p. 68). Is it practical to accomplish the removal of solid matter, such as Mr. Grittinger flows away with his 100 square inches area of opening, through Mr. Lürmann's device."

"A. No. By the Lürmann process it must remain and dissolve in the liquid cinder before it can pass through the small aperture he provides."

Mr. Brevoort, defendant's expert, says (p. 74):

"No attempt is made with the defendant's device to fuse those matters which are not readily melted, but, as in the case of the old open hearth furnace, the unfused materials are ejected from the furnace."

Mr. Weimer (p. 68, Q. 12) says Mr. Grittinger's mode of removing the cinders differs from the old furnace practice,

"from the fact that his opening is sufficient to remove all forein matter along with the cinder, and the violence of flow in such a large aperture is sufficient to accomplish all that was performed with the old practice of shoveling off."

From this we understand that the defendant's reason for saying that the Grittinger process is more like the old open-front process than it is like the Lürmann process is that unfused matters are taken out in both the open-front and Grittinger process, while the Lürmann process (as the defendant understands it) requires that all the materials in the furnace should melted and be discharged in a liquid form.

There is no foundation whatever for the last contention. On the contrary, the patent says (p. 83):

"The dimensions of the cinder block are a little less than the opening in which it is placed, and the space left around it is filled with sand, which can be readily removed in case it is desired to remove the block D to repair it, or *if it is desired to have an opening in the hearth to work through, as when any irregularity in the smelting process has taken place.*"

Mr. Julian Kennedy, manager of the five furnaces of the Edgar Thomson Works and the two Lucy furnaces, all of which are licensed under the patent, describes the form of Lürmann's cinder discharge arrangement used in those furnaces. He says (page 19, Int. 8):

"We use a large conical iron block, cooled by a water coil built in the wall of the hearth. Inside of this is inserted a small conical iron block similarly cooled. In the small end of this is inserted a bronze water-cooled block, having an opening of from an inch and a quarter to an inch and three-quarters in

diameter. This bronze block is closed by an iron plug which is withdrawn when it is desired to tap cinder."

He produces a sketch (original page 90) marked "Complainant's Exhibit Kennedy," which shows this construction, and he describes it by letters of reference thereon (p. 20, Ans. 9).

"*a* shows the wall of the hearth, *b* the largest water-cooled block, *c* the intermediate block, and *d* the small bronze block."

He says that at various times he has run the furnaces without the block *d* for two or three days at a time (Int. 10). They did this when the furnace was not working well and the cinder was not fluid enough to run through the small block (Int. 11). That the size of the cinder discharge opening when the block *d* was not used was about four and a half inches (Int. 14); that on several occasions they have run the furnaces from six to twenty-four hours or longer without the block *c* (Int. 15); that the diameter of the opening when the block *c* was not used was about sixteen inches (Int. 22, p. 21); that on such occasions, in addition to the slag they blew out considerable fuel, ore and limestone (Int. 17); that when working the furnaces without the block *d* and also when working them without the blocks *c* and *d* they flushed the cinder in the same way as when working with the block *d*, except that it was generally more trouble to stop the outlet involving slacking down of the blowing engine (Int. 18); that the cinder opening was stopped with clay and fire brick bats (Int. 19); that it was opened by driving an iron bar through the clay stopper (Int. 20); that the flow of cinder thus made in the clay and fire-brick stopping enlarged it considerably, allowing the escape of considerable hot gases and the blowing out of a good deal of hot coke (Int. 21).

Mr. Robert C. Porter testifies to the same effect (p. 34) as to the practice at the Soho furnace. They use the three cones when the furnace is in good working condition, and if it is not

in good working condition they take out one and sometimes two (Int. 15). The diameter of hole in the inside cone is an inch and a half to two inches (Int. 16) ; the inside diameter of the second cone seven inches (Int. 17) ; and the inside diameter of the third cone fifteen inches (Int. 18) ; frequently run two or three days without the smallest cone (Int. 20) ; never run without the two inside cones except the furnace is working badly. Always blows in (starts the furnace) without the two inside cones (Int. 21) ; there is no difference in the operation of flushing, except that they find it necessary to slack the blast to stop the cinder notch.

Mr. Asmus testifies as follows (p. 26) :

" Int. 63. Did you ever know any of the furnaces which have been licensed by you, and which use the Lürmann improvement, to be operated at any time without the cinder block ; and if so, for how long a period and how frequently?

" Ans. Yes ; I know several. For instance, the furnaces of the Jackson Iron Company, which are charcoal furnaces, are operated for at least twelve years now with closed fronts, without a cinder block proper. The cinder is tapped through a water-cooled, saddle-shaped casting about 18 inches long and 12 inches wide, which casting is set into the wall of the furnace.

" Int. 64. The question is broad enough to include occasional omission of the cinder block. What is the practice among the users of Lürmann furnaces with regard to that?

" Ans. They use cinder blocks with holes as small as possible in ordinary work--that is, when the furnace is in good condition. Whenever the furnace is out of order they take the cinder block out and tap for a while through the larger opening left for that purpose."

This casting, used by the Jackson Iron Company by license under the patent, had an area of 144 square inches, and made a very much larger cinder opening than the one used by the defendant.

Robert H. Coleman Furnaces.

The Colebrook furnaces at Lebanon, Pa., owned by Robert H. Coleman, are operated under license from the complainant,

and they use the same stock exactly as is used by the defendant. Mr. Asmus thus describes the construction of the cinder notch in these furnaces (p. 25, Int., 60), as follows :

"They have closed fronts and tap the cinder directly from the hearth through a small cinder notch with about one and a half inch opening. This notch or block is set in a larger conical casting. The cinder block and this casting are cooled by water."

Mr. Asmus then goes on and describes the provision for getting rid of the bone and other unfused matter in these furnaces as follows (p. 25) :

"Int. 61. Is there any provision in the Robert H. Coleman furnaces for getting rid of what the defendant calls "bone," in case any should remain unsmelted ?

"Ans. I do not know what is meant by bones in stock, but I suppose it is matter which can't be smelted. Provision to get rid of such matter is made in the furnaces in question ; is made in all Lürmann furnaces, as clearly given in the description of the invention in the patent. The cinder block is in such cases slipped out, a larger opening being accomplished by this, through which such matter can be removed. In the patent drawing this opening is protected by the water-cooled plate C. At the Colebrook furnaces, which is the name of the Robert H. Coleman furnaces, at Lebanon, the conical water-cooled casting spoken of takes the place of plate C. It holds the cinder block and serves as a guard in case the cinder block is taken out.

"Int. 62. How would such unfused matter be removed in case the furnace was worked without the cinder block ?

"Ans. The larger hole is filled up with clay and sand, and when cinder is tapped a hole is dug through such sand wide enough to remove the stuff in question. It is blown out with the cinder."

As to what is meant in regard to the expression in the patent "irregularity in the smelting process" Mr. Hahn testifies as follows (p. 39) :

"Int. 26. What is the result of 'irregularity in the smelting process ?'

"Ans. Whenever the furnace ceases to give fluid cinder, then it more or less adheres to the walls, and encloses particles of ore and fuel, which are then protected so much against the

action of the blast, and isolated from connection with each other, as to prevent in the one case the combustion, and in the other reduction, thus causing their descent into the lower part of the hearth and an accumulation of obstructions therein, which, if not removed timely, may lead to still larger accumulations, scaffolding, and final closing up of the entire furnace."

Mr. Asmus testifies to the same thing, referring to the expression "whenever the furnace is out of order" contained in his answer to Int. 64, already cited (p. 26):

"Int. 65. What do you mean by the furnace being out of order?

"Ans. The furnace is out of order in this sense, whenever the cinder is not fluid enough to pass through a hole smaller than about three inches. Some furnaces make constantly sluggish cinder and use cinder blocks with holes from two to three inches wide, while the standard size is from an inch and a quarter to an inch and a half throughout the furnaces in the country."

Mr. Brevoort, the defendant's expert, admits that the Lürmann construction had this feature, because, in describing the invention as set forth in the original patent, he says (p. 70):

"The block is also removable, so that a large opening may be readily obtained from the outside to the inside of the furnace."

The appellant's brief makes the point that the construction shown and described by Kennedy and used in the licensed furnaces differs in form from the construction shown in the patent; that is to say, that the cinder block as used is held in place by a conical-shaped water-cooled plate, while in the patent it is held in shape by a flat water-cooled plate. Not only is this a mere structural difference, but it appears from the record that the licensees obtained the necessary information as to the application and use of the removable cinder discharge block from Lürmann through his assignee Asmus, who testifies (p. 28) as follows:

"Int. 79. In adapting the invention to different construc-

tions and circumstances of furnaces, did you have any assistance or suggestion from any other person?

"Ans. From nobody but Mr. Lürmann, who sent me quite a number of printed drawings showing the ways he altered the furnaces in Germany. They were printed with descriptions in three languages—French English and German—and I made use of the same here as well as in England and France, where I arranged the first furnaces, upon Lürmann's requesting me to do so.

"Int. 81. Do you know where your licensees got the information as to the ability to use the invention without the presence of the cinder block D?

"Ans. They got it from me."

We submit that there is no warrant for the defendant's contention, that the patent in suit is limited to an operation in which all of the refuse matter is reduced to a liquid form and then discharged through a small opening; but that, on the contrary, the patent in suit expressly provides for the operation of the furnace with a large opening also, and for the express purpose of being able to remove from the furnace thick slag, unfused foreign matter and to correct other irregularities in the operation of the furnace. And we also submit that there is no substantial difference between the operation which is carried on in the defendant's furnace and that which is carried on in the complainant's; and also that the defendant cannot escape the charge of infringement, merely because the infringing furnace has a larger water-cooled cinder discharge opening than is ordinarily used in the complainant's furnace.

In reply to the suggestion of defendant's counsel that there are two known and practiced methods of operating blast furnaces, one consisting in discharging mechanically with the slag, through a large hole, the bone and slate and other unfused materials; while the other method consists in discharging the slag through a small orifice and allowing the bone and slate to remain in the furnace until fused with the slag and then discharging the slag and such fused material as a liquid. Edward

S. Cooke, defendant's witness, states that the question which method is the most practical and economical depend

"entirely on circumstances as to the character and quality of fuel used and also to the quality of the ores smelted. With anthracite coal as a fuel and with the average quality as received at the Schuylkill Valley furnaces I would prefer the former method, especially so if sulphurous ores were also used. With coke of a fair quality and ores comparatively free of sulphur I would prefer the latter method."

Thus it appears that the difference between the two methods consists *only* in the use of a larger or smaller opening in the closed breast furnace through which the slag is discharged, which, as we have already shown, is fully provided for in the Lürmann Patent and is utilized in practice by the licensees.

Seventh Claim.

The defendant also rests the defense of non-infringement on the fact that she does not use the method covered by the seventh claim, which is as follows:

7th. The method of controlling the discharge from blast furnaces by regulating the temperature of the slag discharge piece or cinder block, substantially as described.

It is, of course, not necessary to an infringment of the first claim of the patent that the seventh claim for the method just stated, or the claims for the specific construction of the cinder block and its supporting plate (2d, 3d, 4th, 5th and 6th claims) should also be infringed.

The statement of the specification with regard to this method is that

"by allowing much cooling water to circulate through its water channels and pipes the temperature of the block D is lowered sufficiently to allow a coating of slag to adhere and choke its discharge openings, which are of less diameter in the middle than at its ends. By reducing the flow of cooling water the cinder block is allowed to retain a higher temperature, and in consequence the slag is melted out of the discharge openings, and they become clear and open and permit the slag to flow without interruption."

This is evidently a very convenient method of regulating the discharge of the slag, but is inapplicable where the aperture for cinder to flow through is of large diameter, as it would be if the cinder block were removed. It depends, therefore, upon the use of the cinder block, and, as the defendants allege that they use an opening of large diameter, the question of infringement of this seventh claim cannot arise in the absence of proof of the use of the cinder block. We contend, however, that the scope of the first claim is not dependent in any way upon either the use of the cinder block D, or upon the use of the method of varying the flow of cold water through the discharge opening so as to chill the slag, in order to arrest its flow, or as not to chill it so as to allow it to flow continuously.

Mr. Asmus was examined in regard to this method (p. 32) as follows :

" Int. 100. Please state what relation that part of the specification of the Lürmann Patent which relates to the method of controlling the discharge of slag, forming the subject matter of the 7th claim, bears to the Lürmann invention ?

" Ans. It is one of the finer points, which comes in as inferior substance to the whole.

" Int. 101. Under what circumstances is that method practiced and of utility ?

" Ans. Wherever very lean ores are smelted and consequently very large amounts of cinder are made. In this case it is found highly convenient to run the cinder all the time from one iron tap to another. In order to be able to do this the size of the cinder hole is regulated by the amount of water flowing through the cinder block. This does away with the labor, which is indispensable for removing the chilled cinder which fills the cinder channel between the furnace and the place where the cinder is run into cars every time, after cinder is flushed in the ordinary way."

Before closing this section of our brief we desire to note the fact that there is no warrant whatsoever in any part of this specification, either of the original or re-issue patent, that Mr. Lürmann's patent in any way depends upon or involves the necessity of leaving solid refractory substances in the furnace until they are fused so as to flow out through a contracted

opening with the fluid slag, or of making the slag discharge opening so narrow that the flow of the slag can be regulated by the temperature of the discharge opening. These are incidental advantages rendered possible and practicable by Mr. Lürmann's invention of the closed breast furnace with water-cooled slag discharge opening, and the fact that the defendant has adopted the construction of furnace invented by Mr. Lürmann, without availing himself of all its practical advantages, while it may prove the possibility of so doing, cannot, we submit, limit the scope of the invention.

In conclusion we desire to quote the following passage from the opinion of Judge BUTLER (p. 123):

"Second. Has the claim been infringed?

"This question also must be decided against the defendants. Their furnaces are built with closed breasts, distinguishable in no material respect from the plaintiff's, and have water-cooled slag discharges leading directly from the hearth. It is no answer to say that these slag discharges are not water-cooled to the same extent as plaintiff's, nor that the defendants do not use the 'cinder notch,' which his made the subject of plaintiff's seventh claim and designed to regulate more completely the discharge of molten cinder. As we have seen, the plaintiff's patent contemplates the use of the slag discharge without as well as with this notch. If it were true that the slag discharge embraced in the first claim contemplated the constant employment of the 'cinder notch,' the only difference between the defendant's discharge and the plaintiff's thus constructed would seem to be in the size and form of the opening and the degree of water-cooling, which would not be material."

ALLEGED ANTICIPATIONS.

The defendants have set up in their answer certain patents and printed publications of date prior to the Lürmann original patent, as anticipations of the invention claimed in the patent in suit; these are:

1. Bryant's U. S. Patent of December 31, 1836.
2. Stileman & Ellis' U. S. Patent of May 12, 1863.
3. Dalton's British Patent of May 4, 1855.
4. Bedson's British Patent of June 12, 1863.

5. Merle's French Patent of July 27, 1854.

6. Kerl's Metallurgy—description of a tin melting crucible.

7. Percy's Metallurgy—description of blast furnaces.

None of the witnesses for the appellant testifies that any of these alleged anticipations contains the Lürmann invention, and according to the appellant's brief it was not the intention that they should.

On page 21 of the appellant's brief it is said:

"It is not pretended that any of these references show the precise construction claimed by Asmus as Lürmann's assignee; they are introduced for the purpose of demonstrating that, in view of the prior state of the art, his claims must be limited to his specific organization, which we do not infringe, and that any attempt to construe them broadly, as is sought to be done by appellee, would necessarily render them void for want of patentability, as well as of patentable novelty, in view of repeated decisions of the Supreme Court of the United States."

Accordingly Mr. Brevoort, the defendant's expert (p. 73, Q. 9), refers to the Dalton Patent as showing the broad idea of removing the slag through a small hole in a furnace without a fore-hearth, and (p. 76, Q. 16) to the Bryant Patent and to Percy's Metallurgy to show that it was old to provide blast furnaces with water jackets and water-cooled tymp plates.

We are unable to see why the patent in suit must be limited by any of these prior things, or why an attempt to construe the patent to cover a closed-breast furnace having a large cinder discharge opening, such as is used in the defendant's furnace, should render the patent void for want of patentable novelty. The fact is that none of these alleged anticipations shows a closed-breast furnace having a water-cooled cinder discharge opening, and none of them possesses any of the advantages which are obtained by the use of the invention. While on the other hand the defendant uses the invention and obtains the main advantages which arise from such use (p. 14, Int. 21).

As against the testimony of defendant's expert just referred

to, we have the positive evidence of Mr. Asmus (p. 31) that these prior exhibits neither describe nor claim the invention in controversy, and that a person skilled in the art could not construct a Lürmann furnace from anything contained in them.

"Int. 98. Have you examined the following paper exhibits put in evidence by the defendants, namely, Exhibits Kerl, Merle, Percy, Bedson, Dalton, Bryant, and Stileman & Ellis; and if so, please state whether you have found therein, either described or claimed, the invention claimed in reissue No. 3204?

"Ans. I have examined the papers and did not find anything like Lürmann's patented improvement. Kerl refers to a furnace for melting tin; nothing is said about cooling the cinder outlet in any way. Merle shows a fancy sketch of an impossible furnace. The inventor introduces on one side of the furnace gases and chemicals into the hearth. Nothing is said about the cinder outlet as being separate from the outlet for the iron.

"Percy's sketch shows the lower part of an open front blast furnace and the way to protect the sides of the furnace by water-cooled castings. Nothing is said beside this. It shows a style of water-cooled tuyeres for the blast.

"The Bedson drawing does not show a ground plan, and is impossible to see whether it refers to a closed or an open front. Nothing is said about the mode of discharging the cinder."

"The Dalton drawing shows no ground plan, and it is impossible to see whether it refers to an open or closed front. The cinder outlet is marked, but nothing is said that it should be cooled by water.

"The Bryant shows an open front, where the crucible is protected by water boxes. Nothing is said about the mode of discharging cinder.

"Stileman & Ellis show a cupola furnace, not for making iron, but for smelting scrap. Cinder and iron are run out together through a hole near the bottom into a box, where the iron may accumulate and the cinder run off near the top. The whole has no reference to a blast furnace and refers only to the accumulating box which is outside of the furnace.

"Int. 99. State whether, in your opinion, a person skilled in the art could, without other knowledge or information, construct a Lürmann furnace from anything contained in these exhibits?

"Ans. He could decidedly not."

A careful examination of these alleged anticipations clearly substantiates the correctness of Mr. Asmus' testimony in regard to them.

This closes the list of supposed anticipations. It would require a good deal of ingenuity to find Mr. Lürmann's invention even suggested in any of them.

The question to be considered is whether, in reading these prior specifications and publications, you can attribute to them the knowledge contained in plaintiff's patent.

Muntz vs. Foster, 2 Webs. P. C., 105, 107.

It is well settled by numerous decisions, that in order to anticipate a patent "the information given by prior publica-"tions must be for the purpose of practical utility equal to "what is given by the subsequent patents."

Betts. vs. Menzies, 4 Best & Smith Q. B., 966.
Seymour vs. Osborne, 11 Watt, 555.

"It must be admitted that unless the earlier printed and published description does exhibit the later patented invention in such a full and intelligible manner as to enable persons skilled to the art which the invention is related to comprehend it without assistance from the patent, or to make it, or repeat the process claimed, it is insufficient to invalidate the patent."

Cohn vs. U. S. Corset Co., 93 U. S., 366.
Downton vs. Yeager Milling Co., 108 U. S., 466.

Applying the rule thus laid down by this Court, we submit that the defense of anticipation is not sustained by the evidence.

ALLEGED PRIOR USE AT JAMES WOOD & CO.'S WORKS.

The only attempt to show the prior use is contained in the testimony of David Campbell (p. 62, Qs. 25 to 29), to the effect that before 1865, at the works of James Wood & Co., Middletown, they tapped cinder through, beneath and between

the tuyeres. The occasion when this was done was when the fore-hearth of the furnace was chilled up. The tuyeres are said to have been water-cooled. This testimony was objected to as inadmissible under the answer, no notice of the same having been given therein (p. 62). This alleged use is referred to as an "expedient." Campbell is not corroborated by any other witness and the defendant, although having immediate notice of the objection, made no effort to amend her answer or corroborate the testimony of the witness in any way. We therefore submit that the testimony is inadmissible, and that, at all events, it is not of such a character as would be received to defeat a valuable patent.

We do not admit, however, that even if this story is true it proves the use of the invention. Mr. Brevoort thinks that because the fore hearth was chilled up the furnace was practically a closed-breast furnace, and that, inasmuch as the slag was discharged through an aperture cooled by water, it would be an anticipation. But this is not so because the fore hearth was not entirely closed up, for Campbell says (p. 63, Qs. 38 to 42) that they were tapping metal through the fore hearth and that the furnace was working regularly along; that the fore hearth was chilled up about half the time, but was cleaned out whenever chilled up. The probabilities are that occasionally during these chills the furnace would fill up, so that the slag would come on a level with or above the tuyeres, and then, to save the tuyeres and tuyere boxes from being destroyed, they had to permit the slag to run out the back end of the tuyeres. At all events, it is a very weak, unconvincing, unsatisfactory story, and, as has been surmised, was doubtless an account of a mere accidental occurrence, the value of which as a disclosure of this invention was never recognized, and which contributed nothing to the art.

In concluding this section of our brief we will quote Judge BUTLER'S opening of these prior devices (p. 121), as follows:

"The combination of the slag discharge, even if old, with

the hearth of the closed-breast furnace would form a valid claim. While, therefore, it is unnecessary to discuss the novelty of the slag discharge, described as an element in this claim, it is proper to say that I am not satisfied it is old. The record, in my judgment, fails to disclose anything calculated to cast doubt on the novelty of the combination described in the claim, or of the first element in this combination (the closed-breast furnace).

Validity of the Reissue.

The validity of the patent in suit is contested on the grounds that the original patent was not surrendered for good and lawful cause; that the reissue, as granted, is not for the same invention "which was specified in the said original letters patent," but, on the contrary, was obtained on the application of an assignee, without the knowledge or consent of the inventor, for the purpose of expanding or enlarging the claims, so as to cover another and different invention from that described and claimed in the original letters patent, and that the reissue was unlawfully and unwarrantably expanded and enlarged to cover inventions other and different from and broader than those described and claimed in said original letters patent, and that said reissued letters patent are therefore void.

In the first place we call attention to the fact that the original patent was issued on November 5, 1867, and that the reissue was applied for on November 3, 1868, less than a year after the issue of the original, and was issued on November 24 following.

On page 78 of the record the original patent and the reissue are printed together, the parts in italics not being in the original, and the parts in brackets not in the reissue.

A careful comparison will show that there is no material variation whatever between the original and the reissue, so far, at least, as the specification or description of the invention is concerned.

The main feature of the invention is the closed breast of the blast furnace, of which the slag discharge piece, otherwise

called the cinder block D, is an incident, as it cannot be used as described in the specification excepting in connection with a closed breast furnace.

All of the seven claims of the reissue excepting the first are substantially the same as the six claims of the original, the only noticeable difference being that the term "cinder block" is used as an alternative for or in addition to the words "slag discharge." These terms are identical in signification, and refer to the same part of the apparatus.

It is unnecessary, however, to discuss these claims (2 to 7 of the reissue), as the only claim which appellee holds to have been infringed is the first, which is as follows:

"A blast furnace with a closed breast where the slag is discharged through an opening or openings cooled by water, substantially as set forth."

The first question to be considered is whether the subject matter of this claim is described and set forth as the invention of Mr. Lürmann in the original specification. We quote from the original patent (p. 85) as follows:

"This invention relates to furnaces for smelting iron ore, and has for its object to dispense with the 'tymp,' or fore-hearth and the 'wall stone,' now in common use in iron blast furnaces, and to replace the tymp arrangement by such a construction as allows the slag to be tapped directly from the hearth."

The description of the construction of the Lürmann furnace in the reissue follows closely and does not differ in fact from the description of the original, but the significance of the passage above quoted is that it distinctly asserts the arrangement and construction of the closed breast to be the invention of the patentee, and to be the object of the invention.

It will be remembered that in the original specification the fore-hearth, which it is the purpose of the invention to dispense with, is called "the tymp," a term elsewhere used to refer to another part of the furnace.

In the original specification the inventor then proceeds to

describe *his invention* in such a way as most clearly to indicate that it is the closed breast which he refers to and which he states to be his invention. The description given in this original specification is a correct description of the closed breast of a blast furnace with provision for discharging the slag through an "opening or openings cooled by water."

A further and most conclusive proof that the original patent described and was intended to claim the closed breast of the furnace, as a substitute for the old tymp stone arrangement, is found in the statement in the original specification (Record, p. 85, near the bottom) where, in speaking of the old construction of blast furnace, the inventor says:

"By this arrangement the tymp stone constitutes a trap which intercepts the currents of air and causes the air pressure to be exerted directly on the surface of the slag on the hearth. This method of construction has several disadvantages, one of which is the difficulty of keeping the tymp stone and the surrounding parts in repair; another is that, the pressure of the currents of air or wind is limited or counteracted by the column of slag in the tymp; and another is that one side of the furnace being occupied by the tymp, no tuyere can be applied on that side, and consequently the supply of wind is irregularly distributed.

"My *invention* avoids or overcomes these disadvantages in a simple and effective manner."

Now it is manifest from what follows that the improvement that secures these advantages is the use of a closed breast and the absence of the tymp, and this he states to be his invention.

It is clear, therefore, not only that the closed breast furnace of the reissue is the same as that described in the original patent, which is stated in the original specification to constitute the invention for which a patent is claimed.

This being so, the question remains whether, having stated a a certain construction which is fully described to be his invention and the object for which he seeks patent protection, the inventor can be deprived of the right of reissue to claim that which he had omitted to claim in his original patent.

We submit that the inventor is clearly entitled to the first

claim of the reissue under the terms of the statute and in accordance with the decisions of this tribunal.

In the first place, we notice that the reissue application was made within one year after the grant of the original.

In the next place, there is no evidence whatever of any person or persons having used the invention covered by the first claim prior to the date of the reissue (p. 28, Int. 76), so that there can be no estoppel created in favor of any individual or of the public by reason of any acquired rights during the short time which elapsed between the grant of the original and of the reissue. The defendant began to use it in 1878, ten years after the reissue.

There is one addition to the original specification which was referred to by appellant (at the hearing in the Court below) as new matter. After stating that this invention can be easily applied, by those skilled in the art, to blast furnaces of common construction, the reissue explains how this may be done, viz., "by removing the fore-hearth and closing the aperture left in "the breast of the furnace under the tymp stone C with the "cinder block D."

This shows how very little can be found in the reissue which even bears the appearance of being new matter. It certainly is not "new matter," however, in the sense of the statute relating to reissues, as it describes no construction which is not already described in the specification, but merely shows how the old construction of furnace may be altered to adopt the Lürmann invention. Mr. Brevoort's criticism (Record, p. 78) is that if it were attempted to do this "the slag block would be where the iron notch should be, and the slag could not be drawn at all."

This statement is absurd; for it is not said in the specification that the plate C is to be placed below the tymp stone of the old open-breast furnace and the cinder notch below that, but that the aperture left under the tymp stone by removing the fore hearth is to be closed by the plate C and cinder

block. This will be readily understood by referring to the Exhibit Asmus Sketch No. 2 and the drawing of the Lürmann Patent which precedes page 47 of the record.

We have, however, the admission of defendant's expert Mr. Brevoort that,

> "The reissue describes in the specification is substantially the same thing as is described in the original patent though it uses different terms. The drawings in the reissue are the same as the drawings in the original patent. The claims, however, have been altered" (Record, p. 71, Q. 7).

We will now proceed to consider briefly the validity of the reissue in suit in the light of the decided cases, and it will be found, we think, that those decisions which are usually referred to as holding reissues to be invalid have no application to the patent in suit. One would suppose from the position taken by the appellant in this case that it is almost an impossible thing for any reissue to be sustained. If this were so, obviously the statute in regard to reissues would be worse than useless.

In the cases on reissue, especially those decided by this Court, it will be found that it is not the mere fact of reissue, or of a change in the specification or in the claims, which is the cause of the trouble; there is always something else which renders such changes improper, as for example that the patentee has slept on his rights and allowed an undue time to elapse after the grant of the original patent before applying for reissue, the reasonable time being usually two years, in analogy to the right an inventor has to use his invention publicly for that length of time before applying for reissue; or the purpose of the reissue is merely that of expanding the claims beyond the scope of the *described* invention; or for the purpose of claiming that for which the applicant was refused a patent by the Patent Office and deliberately withdrew the claim in order to obtain his patent; or for introducing into the specification some new suggestion of invention, and basing a claim upon it; or for the purpose of

claiming a patent for that which was not claimed in the original, and which the public, relying on the fact of non-claim, have commenced to use before the reissue is applied for. In these cases reissues are held to be invalid, but none of these adverse circumstances apply to the reissue in suit.

We start with the following facts, viz.:

1. That the specification and drawings of the reissue are substantially the same as the original patent. This appellant's expert admits.

2. That the only claim in which a decree is asked in favor of the appellee (the first) is for an invention which is:

a. Clearly and fully described in the original specification.

b. Distinctly stated in the original specification to be the invention of the applicant.

c. Manifestly the same which the original patent states to be the gist of the invention.

3. That the application was made within one year after the date of the original patent.

4. That there is no evidence that the invention was used by the public between the dates of the original and the reissue so that no adverse rights have accrued.

An objection to the reissue is made in the answer that it was obtained on an application of an assignee and without the knowledge or consent of the inventor. A sufficient reply to this is that the reissue was granted under the Act of 1836, which does not require the consent or knowledge of the inventor, and that by the Act of March 3, 1871, it is expressly provided that the requirement that in case of reissue by assignees the specification shall be sworn to by the inventor, if

living, shall not be construed to apply to patents issued and assigned (as was the patent in suit) prior to July 8, 1870.

We contend that in such a case as this the reissue was perfectly proper.

In *Walker vs. Terre Haute*, 44 Fed. Rep., 70-73, Judge GRESHAM says:

"While an inventor may not obtain a reissue enlarging his invention, he may, under proper conditions, surrender his patent and obtain a reissue with *enlarged claims*, not extending, however, beyond the bounds of his *described invention*. It is not claimed that Bragg obtained his reissue to cover improvements made after the date of his first patent, and the defendant's expert testified that the reissue contained no new invention." [That is precisely the case of the reissue in suit, as we have already shown.] "The Supreme Court has never so construed the statute which authorizes reissues as to deny to a patentee, on application made in due time, and before adverse rights have accrued, the right to obtain a reissue *broad enough to cover the entire invention as originally described*, and as he intended to claim it. In *Marsh vs. Seymour*, 97 U. S., 348, the Supreme Court say: 'The patentee may redescribe his invention, and include in the description and claims of the specification not only what was well described before, but whatever else was suggested or substantially indicated in the old specification, drawings or Patent Office model which properly belonged to the invention as actually made and perfected. Corrections may be made in the description, specification, or claims of the patent where the patentee has claimed as new more than he had a right to claim, or where the specification or claim is defective or insufficient; but he cannot, under such an application make material additions to the invention which were not described, suggested nor substantially indicated in the original specifications, drawings or Patent Office model.' The statute authorized the granting of the reissued patent."

Although, as we submit, the reissue in the present case is fully justified by the facts, and in accordance with the existing Patent Act of 1874 (Rev. Stat.) and the decisions of this Court thereunder, it may not be amiss to advert to the fact that this reissue was granted in 1868 under the provisions of the thirteenth section of the Patent Act of 1836, which expressly authorized the amendment of the claims of the original patent as well as of the description of the invention. Prior to the Act

of 1870 the word "specification" always meant the claim as distinguished from the description, as is clearly pointed out in Robinson on Patents, Vol. 2, Sec. 655 and note 2, and admirably elucidated by Mr. Justice BLATCHFORD, in *Wilson vs. Coon*, 18 Blatch., 532-536. Now, the reissue section of the Act of 1836 (§ 13) provides that on surrender of a patent the Commissioner shall "cause a new patent to be issued to the said inventor for the same invention * * * in accordance with the patentee's corrected description *and specification*."

In the case of *Hurlbut vs. Schillinger*, 130 U. S., 468, the original patent was for concrete pavement laid in sections with strips of tar paper interposed between the sections. The only claim was "the arrangement of tar paper, or its equivalent, between adjoining blocks of concrete, substantially as and for the purpose described." This patent was dated July 19, 1870. In May, 1871, a reissue was granted with two claims, one like the claim of the original excepting for the substitution of the words "set forth" in place of the word "described." Another claim was added as follows: "A concrete pavement laid in detached blocks or sections substantially in the manner shown and described."

In this case, as in the patent in suit, the invention covered by the new claim of the reissue was not specifically claimed in the original, and the reissue application was made within one year. A clause had been inserted in the new specification to the effect that "the tar paper may be omitted and the blocks formed without interposing anything between the joints," but this was stricken out by disclaimer.

The reissue was sustained by this Court, and Mr. Justice BLATCHFORD, speaking for the Court, says: "To limit the patent to the permanent interposition of a material equivalent to tar paper would limit the actual invention."

The case of *Eames vs. Andrews*, 122 U. S., 40, is another instance of the application of the principles we are contending for.

In this case the patent (commonly known as "the driven well patent") was issued on 14th January, 1868, and the reissue on 9th May, 1871, more than three years thereafter.

In the original patent the claim was:

"The herein described process of sinking wells where no rock is to be penetrated, viz., by driving or forcing down *a rod* to and into the water under the ground, and *withdrawing it*, and inserting a *tube* in its place to draw water through, substantially as herein described."

The claim of the reissue is:

"The process of constructing wells by driving or forcing *an instrument* into the ground until it is projected into the water without removing the earth upward, as it is in boring, substantially as described."

The objection made by the defendant was that the original specification does not state that the tube driven down to the water stratum is to be made air-tight throughout its whole length, and that the pump is to be attached to the tube by an air-tight connection, and that the invention described and claimed in the reissue is different from that described and claimed in the original. But this Court held that

"It is to be fairly implied from the entire language of the original specification that the tube was intended to be air-tight throughout its length," and that "an air-tight connection at the junction of the pump with the tube was indispensable to the operation of the pump;" and that "even if this were not so the case would be simply that of a specification defective for not containing a full and perfect description of the process *intended* to be patented; that the amended specification does not enlarge the scope of the original invention as *described in* the original specification" (p. 59). And further (citing the opinion of this Court as enunciated by Mr. Justice FIELD in *Russell vs. Dodge*, 93 U. S., 463). that "a defective specification could be rendered more definite and certain so as to embrace the claim made, or the *claim could be so modified as to correspond with the specification.*"

We submit that these examples of the application by this Court of the doctrines of law relating to reissues fully warrant

the reissue in the present case, for, if anything is clear in the case at bar, it is that the original specification not only fully describes the invention claimed in the first claim of the reissue, but distinctly states it to be the invention sought to be patented, the whole described construction, as well as the claims necessarily implying the use of a closed breast to the blast furnace with provision for discharging the slag through an opening cooled by water.

Damages.

The appellant in assignments of error 9, 10 and 11 on page 4 of the appellant's brief, claims that the trial Court erred in overruling the Master's report and finding that the complainant had proven established license fees; in awarding the full license fee as compensation for the use of one claim only; and in awarding a license fee larger than was proved to have been accepted by the complainant from other alleged infringers under like circumstances.

The only other infringers who were placed under like circumstances with the defendant were the Dunbar Furnace Company (p. 133, X. 10) and the Cleveland Rolling Mill Company (p. 131), as they also were adjudged infringers. They both, however, settled with the complainant at the regular rates, which this defendant refused to do.

In passing on the exceptions to the Master's report, Judge Butler (p. 150) says:

"The rule requires a uniform fee within given periods, such as indicates the market value of a license at the times specified. It need not be uniform throughout the life of the patent and could not be. As the monopoly approaches its close the value necessarily diminishes and the price of its use must be correspondingly less. Nor is it important that a larger or smaller sum is demanded and paid under special circumstances as where licenses result from the settlement of suits for or controversies about infringements. Here, as in all extraordinary cases, other considerations than the value of the license enter. It is sufficient that the price is uniform when the cir-

cumstances are similar and such as ordinarily exist when these contracts are made.

"The proofs here show that the license fee demanded and paid in the beginning was one hundred and fifty dollars per foot across the boshes, averaging about $1,500 per furnace, and later one hundred dollars—about $1,000 per furnace. After some years it was placed at one thousand dollars per furnace, regardless of size. This latter sum was thereafter adhered to uniformly under ordinary circumstances and many licenses were taken at that rate. It was never departed from except where licenses arose from settlement of suits for or controversies about infringement, and one or two instances where several licenses were granted together toward the expiration of the patent, and these, as well as other unusual circumstances, operated to induce and justify a reduction. When the Master says no reason is given for this latter reduction he must be understood as meaning no sufficient reason. The proofs show the reasons above stated, and we think them sufficient to justify the reduction and exclude these licenses from consideration. As respects the infringements here involved, two commenced in the summer of 1878 and the third in 1881. These are the periods, therefore, to which inquiry must be directed, and we think the proofs show the existence at both times of a well-established and uniform fee of one thousand dollars demanded and paid under ordinary circumstances."

Referring now to the testimony on part of complainant, it appears that on January 1, 1880, the license fee was fixed at $1,000 a furnace regardless of size (p. 130). Samuel E. Moore (p. 134) testifies of the purchase by the Edgar Thomson Steel Company, Limited, on May 27, 1880, of a license for furnace B for $1,000. William J. Moorhead (p. 135) testifies to the purchase of a license for the furnace of Moorhead, McCleane & Company (Soho furnace), on May 21, 1880, for $1,000. On page 130 is a list of fourteen furnaces licensed at the uniform rate of $1,000 between October 11, 1883, and May 19, 1884.

These are all cases of licenses granted *under ordinary circumstances*, that is, they are cases where the public came forward and purchased licenses at the rate which the patentee had fixed for the same, without constraint or any unusual circumstances surrounding the transaction. They are cases in which the public regarded the invention as having that value,

and the patentee was willing to sell the right at the price which the public was willing to pay.

Wholesale Rates.

There is a second class of cases which we can classify under the head of wholesale rates. The furnace building firm of Witherow & Gordon negotiated for the granting of six licenses. They represented that they were "desirous of purchasing wholesale," and in view of the number were entitled to a good concession (p. 130), and the complainant, in view of this consideration, made a reduction to them of 33 per cent. in the price, receiving $4,000 for six licenses. The Roane Iron Company of Chattanooga hearing about this arrangement immediately opened negotiations of being licensed on the same terms. Their furnaces were in the same region as the ones licensed through Witherow & Gordon, and they claimed that they ought to be put on the same basis as their neighbors, and Mr. Asmus considering this, and also being desirous of closing up his business here and going to Germany to join his family, assented to the proposition and received $1,333.34 for two licenses (p. 131, first paragraph).

Mr. Moore (p. 134) gives an account of the licensing of the Lucy furnace No. 2 and of the Edgar Thomson furnaces C, D and E for the sum of $3,500, and in answer to Int. 3 he says that the reduction was on account of the number of furnaces. In these cases there was a good and sufficient reason for the complainant to make a reduction in his royalty and the principle of selling cheaper at wholesale than at retail is recognized in all reputable branches of business, and is not repugnant to the fact of an established license fee. Indeed the reduction is based on and measured by the established license fee.

Recoveries and Settlements.

In a suit against the Cleveland Rolling Mill Company for a furnace the Master awarded the complainant $1,000 for a furnace, which was paid (foot of p. 131).

On January 10, 1882, Graff, Bennett & Company, of Pittsburgh; on August 3, 1882, Raney & Berger; on November 24, 1882, Hogsett, Hanna & Company; on February 14, 1884, the Rock Hill Iron Company; and on May 15, 1884, the Cherry Valley Iron Company, of Ohio, paid license fees of $1,000 a furnace after the filing of bills for infringement.

Other Licenses.

In addition to the foregoing, it appears that the Edgar Thomson furnace A was licensed on April 11, 1879, for $1,000 (Exhibit A, p. 135). This was before the time when the $1,000 rate was adopted, but the reason for the reduction is apparent in the last clause of Exhibit A (p. 135), it being a contract by which the Edgar Thomson Steel Company, Limited, was to pay a definite sum ($1,000) whenever they introduced the improvement into a furnace. As this company had a large number of furnaces, it was desirable, of course, for the complainant to hold out an inducement for the introduction of the improvement into its other furnaces. It is merely an application of the principle of selling at wholesale for a less price than at retail. The royalty was reduced to $1,000 before any more of these furnaces were equipped with the improvement. It is quite possible that this transaction was what led the complainant to reduce his royalty to a uniform rate of $1,000 a furnace on January 1, 1880.

The Coleman Furnaces.

The defendant produces evidence of the grant of a license on November 3, 1883, for four furnaces to Robert H. Coleman for the sum of $1,500 (see testimony of Hess, pp. 143 to 145). These furnaces were known as the Colebrook furnaces at Lebanon, Pa., and the Anthracite furnaces at Cornwall, Pa. The Colebrook furnaces were completed in 1881 and 1882. The anthracite furnaces were old furnaces built in 1849 and 1852. It seems, however, that this was a compromise of a doubtful question of infringement, at least as to some of these furnaces. Hess says (p. 144, Q. 5).

"Suit had not been brought but was threatened and rather than have the expense of a lawsuit we made this settlement. There was a strong doubt in our minds whether we were infringing on the patent for which a license was claimed, but we did not care to be the defendant in a lawsuit with regard to the matter."

And on page 145 (Q. 17):

"We did not believe we were infringing his patent, but as there was a doubt about it we satisfied him in preference to defending a suit."

The Brock License.

Defendant also examined Henry T. Euston, superintendent of the Lebanon furnaces operated by A. & H. Brock. He testifies that there were two of these furnaces. It appears that the complaint brought suit against A. & H. Brock for infringement of the patent and that the suit was settled and discontinued upon the payment of $1,000, which was stated to be in full of all claims and demands of the complainant. The complainant paid the costs. On cross-examination, however, this witness identified a letter from A. & H. Brock to the complainant, dated February 27, 1884 (p. 147), from which it appears that only one of these furnaces was an infringement, and, therefore, the settlement of $1,000 would cover the

royalty upon the ~~other~~ infringing furnace, the only deduction being the payment of the costs by the complainant, which would be a trifling sum and was a small concession on the complainant's part to avoid litigation.

The Meily License.

The defendant also called Richard Meily (p. 147). He testifies that he was a member of the firm of J. & R. Meily, Lebanon, Pa.; that they had a furnace in blast which was built in 1868; that some months previous to May 22, 1884, they received a demand from Mr. Asmus for a royalty; that he thought the suit was brought on a mistake as to the construction of the furnace; that Asmus brought it before seeing the furnace, and that he settled the case and granted the license for $100. The license is in evidence on page 148 and it closes with this sentence:

"The above sum has been stipulated by special agreement, the patent being nearly run out and Messrs. Meily not knowing yet how soon they will apply the improvement."

It is apparent from this that the parties agreed that there was no infringement, and that the improvement was not embodied in the furnace. The furnace was in blast and the patent would run out in November, 1884, about six months from the date of the license; and it was entirely improbable that the furnace would or could have been changed within that time to embody the improvement. It would seem that the $100 was probably paid to cover the costs of the suit. In short, the parties compromised the matter.

We will note here that before the accounting began the complainant went to Germany, and was not available for the purpose of testifying except at great expense, which was not justified by the amount at stake.

We submit, however, that the evidence is ample to prove *a license fee which was adhered to uniformly under ordinary*

circumstances, and that many licenses were taken out at that rate. Where it was departed from it was for the purpose of selling by wholesale, or for the purpose of settling suits and terminating expensive and troublesome litigation.

We submit, therefore, that the Court below did not err in finding that "the proofs show the existence of a well-established and uniform fee of $1,000 demanded and paid under ordinary circumstances."

As to the tenth assignment of errors, that the Court erred in awarding a full license fee for the infringement of but one claim, we cannot do better than to quote from the report of the Master his finding on the subject, which was approved by the Court below (p. 126), as follows:

"It is undoubtedly true that the general rule is that where less than the whole invention has been infringed evidence must be given to show the value of the part appropriated (*Proctor vs. Brill*, 4 Fed. Rep., 415; *Wooster vs. Simonson*, 16 Fed. Rep., 630).

"This general rule fails where the claim infringed is shown to be the only one of the several claims of the patent which has or had any value or where it is shown that the different claims of the patent are for substantially the same invention (*Westcott vs. Rude*, 10 Fed. Rep., 830).

"It also fails in cases where the claims of the patent other than the one or ones in regard to which the infringement has been decreed are merely for devices or instrumentalities in which the invention specified in the claim or claims infringed may be embodied or by the aid of which it may be practiced—that is to say, in cases where the claims not infringed are structural only (*Willimantic Thread Co. vs. Clark Thread Co.*, 27 Fed. Rep., 367; *Cleon Tondeur vs. Stewart, Estep & Co.*, No. 14, Nov. Term, 1885, Circuit Court of the United States for Western District of Pennsylvania, manuscript decision).

"It was admitted before the Master by counsel for the respective parties that the use of the things specified in the claims 2, 3, 4, 5, 6 and 7 of the patent in suit would at the same time necessitate the use of the invention specified in claim 1 and the consequent infringement of such claim. The Master is of opinion that the things specified in claims 2 to 6, inclusive, of the Lürmann Patent are but structural or specific forms of devices by the aid of which the invention of claim 1

of the patent may be constructed and worked; that, therefore, said claims are structural and are comprehended within the scope of claim 1, and that, therefore, said claims, under *Willimantic Thread Co. vs. Clark Thread Co., supra*, are not entitled to be credited with any part of a full-established license fee under the whole patent.

"Claim 7 of the patent in suit is for a method of controlling the discharge of slag from a blast furnace by regulating the temperature of the slag-discharge piece or cinder block. No evidence has been offered by the parties as to the value of the invention specified in this claim or as to the existence of any separate established royalty or license fee therefor. It is admitted by counsel for the respective parties that the practice of the method of this claim could only be effected by the use of the invention specified in claim 1 of the patent and by the consequent infringement thereof. It is in evidence on the part of the complainant that a large number of licenses under the patent in the use of the invention of claim 1 do not employ the method specified in claim 7. There is no evidence in the case before the Master of the use of the method of claim 7 by any one.

"It was admitted by their counsel in argument before the Master that the respondents did not regard the method of claim 7 as being of any practical value, and that had they so regarded it they would have adopted and practiced it."

In passing his opinion on the exceptions to the Master's report Judge BUTLER referred to this point as follows (p. 151):

"We find no substance in the objection that the device covered by claim 7 was not used by respondent. The claim infringed (the first) covered the entire invention. The seventh is structural, merely covering a method of constructing the 'slag discharge piece' so as to regulate the cooling process embraced in the first. The Master did not pass on this question. We may infer, however, from what is said, that he considered it immaterial. The general rule is that where less than the whole number of claims has been infringed evidence must be adduced to show the value of the part taken. This is inapplicable, however, where, as here, the claim infringed embraces the whole invention, and the others are simply structural (Wescott vs. Rude, 10 Fed. Rep., 830; Willimantic Thread Co. vs. Clark Thread Co., 27 Fed. Rep., 367; Cleon Tondeur vs. Stewart, Upp & Co., No. 14, Nov. Term, 1885, Circuit Court, Western Dist. Penna).

"The respondent admits that the several claims between the first and seventh are of this character. We think it reasonably plain that the seventh also is. Furthermore, the proofs show that the license fee paid was the value placed on the use of

the invention, irrespective of the device covered by the seventh claim. While it is not shown that this device was ever used, it is shown that generally it was not. It seems to have been regarded as valueless, and for this reason was not used by the respondent. The Master reports that 'it was admitted by their counsel in argument before the Master that the respondents did not regard the method of claim 7 as being of any practical value, and that had they so regarded it they would have adopted and practiced it.'

"This view respecting the value of the seventh claim is of itself conclusive. It is said the Master is mistaken respecting the imputed admission. However this may be, he virtually reports the matter covered by the claim as valueless, and the proofs seem to justify this conclusion."

The testimony here referred to in reference to the seventh claim is as follows:

Walter Kennedy (p. 149, Ints. 6 to 10) says that the flow of the slag from the Lucy, Isabella and Edgar-Thomson furnaces is not regulated by variation in the flow of the water. Herman Schulze-Berge says the same thing in regard to the Edgar-Thomson and Pennsylvania furnaces (p. 140, Q. 7); also with regard to the Norton, Cambria, Bethlehem, Isabella and other furnaces (Ints. 8 to 10). Robert C. Porter (p. 141) gives the same testimony with regard to seven furnaces in Youngstown, and four in Sharon and in Pittsburgh. He says (p. 142, Int. 6): "I don't know of any that change the volume of water to control the flow of slag;" and in answer to Int. 8 he says that he has never known of the method having been practiced.

We therefore submit that it was not error on the part of the lower Court to hold that the use of the first claim was a substantial use of the whole invention, the other claims being merely structural in character, involving the use of the first claim and *per se* of no value.

Answer to Various Points in Appellant's Brief.

The Direction in the Patent as to Applying the Invention to Old Furnaces.

On page 30 of appellant's brief a quotation is made from the testimony of Mr. Brevoort (p. 78, Ans. 18) in reference to the following paragraph in the reissue, viz.:

"This invention can be easily applied by those skilled in the art to which it belongs, to blast furnaces of the common construction by removing the fore-hearth and closing the aperture left in the breast of the furnace under the tymp stone by inserting the plate C with the cinder block D."

Mr. Brevoort says:

"I think this statement is utterly untrue. If it was attempted to be put in practice the slag block would be where the iron notch should be, and the slag could not be drawn at all. In the drawings of the Asmus reissue the reverse of this arrangement is there shown. The plate C is placed under the tymp arch and not below the tymp stone."

The appellant's brief says: "This charge remains unanswered by the complainant." This testimony of Mr. Brevoort's is so wrong on the face of it, that it is only necessary to look at the patent and the defendant's construction to see that he has answered the question erroneously under the idea that the dam of the ordinary open-front furnace is what the patentee means by the expression "tymp stone."

Referring to the defendant's open-front construction shown in Drawing No. 1, opposite to page 116, we find back of the water-cooled dam plate a part marked "dam stone," and above the fore-hearth is a plate marked "water-cooled tymp," secured to the part of the furnace which overhangs the fore-hearth. On the lower end of the water-cooled tymp is a part marked "clay stopper." The suggestion of the patentee is that this construction may be changed to the patented construction by

removing the fore-hearth. The defendant did this, as shown by Drawing No. 3 (following page 116) of the record, by moving back the water-cooled dam until it came under the water-cooled tymp. Then she took out the iron casting marked "water-cooled tymp," and inserted in place of it another water-cooled iron casting, which is marked in Drawing No. 3 as a "water-cooled tymp" also, but it differs from the old one, in that it has *an arch-shaped opening through it* and the cinder is tapped through this arch-shaped opening instead of being compelled, as in the old construction shown in drawing No. 1, to pass under the clay stopper on the lower end of the water-cooled tymp. That part of the furnace to which the water-cooled tymp in drawing No. 3 is attached is what Mr. Brevoort calls the "tymp arch," but which is known in the trade and referred to in the patent as the "*tymp stone.*" In other words, the stone or wall or arch to which the water-cooled casting marked "water-cooled tymp" in the defendant's drawings is attached is the "tymp stone" referred to in the patent. This explanation will show the mistake into which Mr. Brevoort has fallen, which was doubtless due to his ignorance of blast-furnace construction and practice and not to any intention on his part.

SUBJECT-MATTER OF FIRST CLAIM NOT ON AGGREGATION.

On page 42 of appellant's brief the point is made that "even if the construction covered by the first claim of the reissue were novel it would be unpatentable, there being no patentable relation between a closed breast furnace and a slag discharge opening cooled by water." The argument in support of this point is that the slag discharge opening would perform its function as such, equally well whether the furnace had an open or closed breast.

The reply to this is that the claim is for *a closed breast furnace*, subject, however, to the limitation that the slag is discharged therefrom through an opening or openings cooled by

water. The reason for this limitation has been explained, namely, that such a discharge opening is necessary for the preservation and use of the furnace. But even if this were not so, we know of no reason why a patentee may not limit his exclusive right to an invention by confining its use within narrower limits than he would be entitled to under the law. Indeed this was the case in Keystone Bridge Company vs. [illegible], where the patentee confined himself to the *use* of his invention and excluded by the form of his claim the manufacture and sale. In the present instance the patentee chooses to limit his patent to a closed breast furnace *in which* the cinder is discharged through an opening or openings cooled by water. The invention is the closed breast furnace. The testimony shows that a closed breast furnace would not perform its function as such (except for a very short time) without a water-cooled cinder discharge opening. Since, then, the performance of the function of the furnace depends upon the union with it of a cinder discharge opening cooled by water, there is clearly a patentable combination between them. The claim, however, is not in the form of a combination, and it is unnecessary to regard it as such. It is for a concrete device having certain characteristics.

Recovery Not Limited to Number of Claims Used and Length of Period of Use.

On page 82 of appellant's brief under the head of "Recapitulation" is the following:

"1. Lürmann's Patent ran for seventeen years and contained seven claims.

"2. His licensees were entitled to use the subject-matter of these claims during its entire period.

"5. Defendant having used one-seventh of the claims for one-fourth of the period of the patent is entitled to a corresponding reduction of the alleged established license fee."

We have already referred to the fact that the first claim of the patent was the important claim, and that the remaining six

claims were structural in character and involved merely the use of the first claim. Aside from that they have no value. This ground was taken by the Master and approved by the lower Court.

So far, however, as the question of the period is concerned, we desire to say that the evidence (p. 130, top of page) shows that prior to January 1, 1874, the complainant charged $150 a foot for every foot across the boshes or widest part of the furnace. On January 1, 1874, this royalty was reduced to $100 a foot, and on January 1, 1880, it was further reduced to $1,000 a furnace, regardless of size. Under this last schedule a great many licenses were granted under ordinary circumstances. The Master in the case against the Cleveland Rolling Mill Company assessed damages at that rate, and a large number of settlements were made with infringers at that rate. The defendant's furnace is known as the North Cornwall furnace. It was started as an open-front furnace in 1875 and was changed to a closed-breast furnace in 1878 (p. 55, Q. 4). The infringement continued from 1878 until the expiration of the patent in November 24th, 1884. The license fee of $1,000 a furnace was fixed on January 1, 1880, when the patent had about four years and ten months to run, and the evidence shows (p. 130) that as late as May 19th, 1884, licenses were taken out in the ordinary course of business at the rate of $1,000 a furnace, and that between April 11, 1879, and the date of the expiration of the patent nineteen licenses were granted under ordinary circumstances at the $1,000 rate. If the verdict of the public as to the value of this improvement was that it was worth $1,000 for periods ranging from less than one year up to six years, then surely the patentee is entitled to the same rate from an infringing use of seven years.

We call attention to the case of *Stulz vs. Armstrong*, 25 Fed. Rep., 147, where there was evidence of an established license fee. The defendant used two of the infringing machines for

three years, and four of them for eighteen months only. Judge ACHESON found that the complainant was entitled to full license fees. The Court said:

"Why should the defendant not pay the plaintiff his established license fee? Is the willful infringer to be favored above his honest competitor in business, who pays for a license to use a patented improvement. If one exercises the privileges of a licensee, shall he be heard to deny his liability to pay the fixed price for the right?"

We call attention to the case of *Kendrick vs. Emmons*, 15 O. G., 966, where the evidence showed that some of the machines of the defendant infringed three claims, others only one claim. The complainant proved that he had granted licenses for the use of machines similar to those employed by the defendant at a certain rate. The defendant offered evidence to prove that a large part of his machines infringed only one of the three claims mentioned in the decree. The Master excluded the evidence and assessed damages for all the machines at the usual rate. The Court said:

"The evidence as it stood justified and required the Master to find that for precisely such an infringement as was admitted here precisely this royalty had been usually demanded and paid."

The evidence shows (p. 20, Int. 63) the grant of a license by the complainant to the Jackson furnace for precisely the same construction of water-cooled cinder notch as is used by the defendant, namely, an arch-shaped, water-cooled casting having an opening twelve inches wide. This furnace embodied only the first claim of the patent, as also did the use by Kennedy, Porter and others of water-cooled cinder openings 4½ to 16 inches, and 7 to 15 inches in diameter.

ALLOWANCE OF INTEREST.

On page 80 of appellant's brief the allowance of interest is discussed and various decisions are cited to establish the point

that there should be no allowance of interest prior to final decree.

Silsby vs. Foote, 20 Howard, 386, was a case in which there was a decree for defendant's *profits* with interest. The Court say :

" The majority of the Court are of the opinion that there was error in the allowance of interest on the profits, found for the complainant."

Mowry vs. Whitney, 14 Wallace, 620, was also a case in which the decree was for profits and interest, and in it the Court say :

" We add only that in our opinion the defendant should not have been charged with interest before the final decree."

Littlefield vs. Perry 21 Wallace, 205, was also a case in which there was a decree for profits and interest. The Court say :

" The Circuit Court, however, in rendering its final decree, added interest to the amount found by the Master to be due upon the amount for profits. In *Mowry vs. Whitney (supra)*, it was held that interest is not allowable in such cases except under peculiar circumstances. The testimony thus far presented in this case does not, in our opinion, justify such an allowance. It will be for the Court to determine, upon the coming in of the new report, accompanied by other evidence, whether the conduct of the defendants has been such as to subject them to liability in this particular. Profits actually realized are usually, in a case like this, the measure of unliquidated damages. Circumstances may, however, arise which would justify the addition of interest in order to give complete indemnity for losses sustained by willful infringements."

Parks vs. Booth, 102 U. S., 96 was also a case in which a decree was entered for the defendant's profits.

Illinois Central Railroad Co. vs. Turrill 110 U.S. 301 is also a case in which there was a decree for profits and interest. The Court say :

" As a general rule a patentee is not entitled to interest on profits made by an infringer. The reason is that profits are re-

garded in the light of unliquidated damages (*Parks vs. Booth*, 102 U. S., 106); but in many of the cases it is said that circumstances may arise in which it would be proper to add interest."

Brady vs. Atlantic Works, 3 B. & A., 577, was also a case of profits. Judge CLIFFORD says: "Interest on profits was properly refused."

The Steam Stone Cutter Co. vs. The Windsor Mfg. Co., 17 Blatchf., 24–33, 33, was a case of a decree for profits, in which the Court allowed interest from the date of decree.

These cases, however, differ from the present case because here there is an established license fee, and under the doctrine laid down by Mr. Justice STRONG in *Locomotive Engine Safety Truck Co. vs. Pennsylvania Railroad Co.*, 5 B. & A., 514, 518, the complainant is entitled to a license fee because the amount of the royalty was fixed, and therefore interest was only compensation for the delay of payment of a liquidated sum. This case was reversed (110 U. S., 490), but not on this point. See also *Sickles vs. Borden*, 3 Blatchf., 535.

Under these decisions the complainant is entitled to interest from 1878 to November 24, 1884, the date of the expiration of the patent. The precise time in 1878 when the defendant's furnace was changed and put into blast does not appear from the testimony, and therefore no earlier date than December 31, 1878, can be fixed.

In case, however, the point is made that there is no evidence of the defendant having had notice of the complainant's rights and demands, and that therefore no liability for interest would arise until the time of the bringing of the suit, we would call attention to the admission of the defendant in paragraph IX. of the answer (p. 6), that a demand for royalty was made shortly after the decree in the Dunbar suit. On page 91 it appears that the decree in the Dunbar suit was entered on March 11, 1879.

It is also in evidence (p. 16, Int. 23), that the complainant

called upon the defendant on May 17, 1883, and made a demand for royalty at that date. This is admitted in the ninth section of the answer (p. 7), as follows :

" Upon their refusal to listen to his demands without knowing specifically what they were, complainant's attorney wrote specifying the alleged ground of infringement, referring to the Dunbar suit, and suggesting a settlement ; that upon the advice of counsel, after full investigation, they declined to recognized said complainant's alleged rights, and for more than three years they heard nothing more of complainant's alleged rights, during all of which time their furnaces were in operation with the full knowledge and acquiescence of said complainant."

The interval between 1879, when the first notice was sent, after decree in the Dunbar suit, until the complainant called upon them in May, 1883, is here referred to as a period of " more than three years."

We submit, therefore, that, even if notice was necessary, the complainant is entitled to interest from December 31, 1879, upon the license fee of $1,000 found by the Court below.

W. Bakewell,
Thomas B. Kerr,
Counsel for Appellee.

Transcripts
of
Records
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Supreme Court U. States

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